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ABSTRACT

The symposium papers in this document describe specific applications of research management techniques currently being used by research and development organizations. Topics of the papers are based on subjects practicing R & D managers have found important in the management of research. Although the symposium was not specifically designed to include all aspects of research management, the papers when taken together comprise a "working" model for managing the information associated with R & D activities. Topics of the five papers include (1) a prototype research management system whereby information is organized for easy retrieval by research managers, (2) a description of organizational operations procedures and policies that reduce the administrative burden on researchers and developers and assist management in operating an effective R & D organization, (3) a system for using the computer to manage information about the financial expenditures of an R & D organization, (4) the application of a research management procedure, the Convergence Technique, with the Reading Research Program sponsored by the U.S. Office of Education, and (5) the steps necessary for planning and implementing a research and development program. (Author/DN)

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APPLICATION OF RESEARCH MANAGEMENT TECHNIQUES

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PREFACE

The Special Interest Group (SIG) On Research Management of the American Educational Research Association was initially conceived by members of the Association to "provide a locus within AERA for activities intended to foster more effective and appropriate application of research results in educational practice". The SIG has the following basic objectives:

1. To promote meaningful discourse about the management of research among the members of the Special Interest Group on Research Management. (The term "research" includes research, development, evaluation, dissemination of knowledge, diffusion of developments, and related activities.)

2. To promote dissemination activities designed to improve the management of educational research.

3. To encourage the scientific study of the management at all administrative levels of educational research efforts.

4. To identify and clarify issues and processes related to the selection and training of educational research managers.

Among its activities, the SIG sponsors files of research and research related publications, meetings at national, regional, state and local levels, issues periodic publications, acts as a clearing house of information and conducts liaison with counterpart groups and committees of other professional societies and associations.

INTRODUCTION

Don B. Croft and Adolph J. Koenig

The Special Interest Croup for research management presented a symposium on Applications of Research Management Techniques at the annual meeting of the American Educational Research Association in New York City, February 6, 1971. Panel members for the symposium were selected from organizations conducting research and development. Each panel member presented a paper describing specific applications of research management techniques, and then responded to questions from members of the audience.

The thrust of the symposium was upon applications in order to provide symposium participants with a description of research management techniques currently being used by R&D organizations. Although the symposium was not specifically designed to include all aspects of research management, the papers when taken together comprise a "working" model for managing the information associated with R&D activities.

It is important to note that the topics of the papers were selected by people working in R&D organizations. Practicing R&D managers presented topics that they had found important in the management of research. Pressing needs in an organization provide the impetus for the development of systematic ways of managing information. Accordingly, the emergence of specific research management techniques carries with it the implicit assumption that the organization placed a high priority on a particular aspect of reserach management. Now, a brief resume of the salient aspects of each paper is presented.

The prototypic reserach management system described by Don B. Croft includes techniques for organizing and managing information about, 1) projects currently being conducted by the organization, 2) reports and products completed by the organization, 3) the background and experience of members of the organization, 4) procedures for preparing proposals for R&D projects, 5) reporting the activities of the organization, and 6) securing evaluative information about R&D reports.

Croft identifies specific types of information for describing the activities of R&D organizations, and presents techniques for organizing the information so that it may be easily retrieved by research managers. Thus, the use of this prototypic system would allow research managers to meet many of the requests for descriptive information about the organization from members of the public or the educational profession.

Dan Woolpert discusses a topic which, for the most part, has been ignored by the R&D community. The topic, organizational operations, described the procedures and policies that reduce the administrative burden on researchers and developers and assist management in operating an effective R&D organization. Specifically, "An Operations Manual for Research Organizations", describes the policies and internal operating procedures of the Wisconsin R&D Center, and includes the standing operating procedures for the following topics: 1) Contractual Commitments, 2) Governing and advisory groups, 3) Personnel Policies, 4) Program Planning and Budgeting, 5) Technical Development Programs, 6) Dissemination Programs, and 7) Operations and Business Activities. In brief, the Woolpert handbook opens to view an operational set of guides for establishing standardized procedures for conducting R&D activities.

John Vinsonhaler proposes a system for using the computer to manage the information about the financial expenditures of an R&D organization. The paper also describes the value of management information systems (MIS) for the administration of scientific research projects. The scope presented included: 1) description of an MIS technique containing a practical method of providing information on university research projects, 2) a case study describing the use of an inexpensieve computerized MIS to manage the finances of an educational research project and 3) comments on the value of the MIS approach in other areas of research management supporting applications such as literature searching, data collection, and statistical analysis.

Monte Penney discussed the application of a research management procedure, the Convergence Technique developed by Louis Carrese and Carl C. Baker, with the Reading Research Program sponsored by the U. S. Office of Education. Penney candidly pointed out some of the problems that were faced in applying the technique and, in addition, discussed implementing procedures for the technique.

J. William Smith and John L. Yeager discussed the steps necessary for planning and implementing a research and development program. The phases of R&D planning that they see as critical to the process include: 1) policy review, 2) strategic planning, 3) factual planning, 4) allocation of resources, and 5) monitoring. In addition to descriptions of each phase in detail, they provided flow charts identifying the component of each phase. Smith and Yeager also included a model for the evaluation of management planning techniques, and presented illustrative data which compared techniques which are commonly used in the planning process. The communications techniques which were compared included bar-charts,

PERT, Convergence, and PPBS.

In the next section of this report, the papers read and discussed at the SIG symposium are presented. Additional written information or the products associated with each system may be obtained by writing the authors.

A PROTOTYPIC RESEARCH MANAGEMENT INFORMATION SYSTEM

Don B. Croft[1]

1. INTRODUCTION

Following the passage of the Cooperative Research Act of 1954, the number of R&D projects conducted by educational institutions has increased substantially. The massive financing of R&D projects by the Federal Government has had an impact upon the procedures for managing and accounting for the funds associated with these projects. Due to the number of R&D projects now being conducted, it is evident that there is a need to develop new systems for organizing and managing the information associated with the R&D activities conducted in an organization.

The purpose of this paper is to describe a prototypic system for managing the information about the R&D activities conducted by an organization. The system outlined in this paper was intended for individuals performing research management functions within an organization. As the system has been conceived, the concept of research management includes three general functions. The three research management functions include:

1. collecting descriptive information associated with the R&D activities in the organizations
2. conducting objective and systematic analyses of the information as a basis for reporting the accomplishments of the program
3. providing evaluative reports about the organization's R&D projects for input to the decision-making process

At this point, it is necessary to define what is meant by the three terms description, analysis and evaluation.

Description--refers to reliable and valid information about the projects being conducted, and the personnel associated with the organization. Analysis--refers to the formulation of statistical or analytical reports about R&D projects and organizational activities. Evaluation--refers to obtaining ratings from qualified outside consultants about the organization and the projects conducted by staff members.

Once the position has been taken to develop a system for collecting information about the R&D activities being performed by the organization, then the next step is to select the kinds of information that should be included in the system. As one looks at an organization conducting R&D,

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he is overwhelmed by the complexity and multiplicity of the operations occuring in the organization. At this point, it is easy to state that it is impossible to develop a system which completely describes all the activities that occur. In all probability this is correct, but on the other hand, research managers must begin, and they begin by choosing what information should be collected, and developing "working systems" for organizing the information.

When the activities of an R&D organization are examined closely, it is discovered that the following three terms are useful categories:

1. Personnel
2. Substantive Program
3. Financial

In other words, the activities of an R&D organization may be arbitrarily but usefully, classified into three components: people, projects, and money. At this point, it is important to delimit the scope of the Prototypic Research Management System. In this paper only the system for organizing and managing information about the personnel and substantive projects categories is discussed. No mention of the operations, planning, and financial aspects of research management is presented.

However, before the research management system is discussed, it is important to present some reasons, why an organization should use a system for managing research activities. The following list provides some of the reasons.

1. to inform others about the projects being conducted by the organization
2. to provide information about the projects to individuals in the organization who manage the projects
3. to meet the frequent inquiries from outside individuals about the R&D activities of the organization
4. to provide a basis for conducting analyses and evaluation of the R&D programs
5. to assist in meeting the requirements for reporting information to agencies which financially support the projects being conducted
6. providing procedures for teaching new staff members about the organization
7. providing evaluative feedback to members of the organization

A research management system is composed of separate components, each describing salient facets of organizational activity. The following

outline describes the type of information included in the Prototypic Research Management System.

1. ongoing projects
2. completed projects
3. completed products and materials
4. staff members
5. consultants
6. organizational progress reports
7. preparing proposals
8. evaluation reports

In the next section of this report, each component of the system is discussed.

II. CURRENT PROJECTS

R&D organizations receive requests for information about the projects that currently are being conducted by staff members. Meeting these requests for information about the substantive projects may be a burdensome task unless procudures are established for retrieving information quickly and in a form which communicates to others. In addition, it is also economical if the information has been prepared in a form that can be easily reproduced by a copy machine. In this section, the following three components of the system for retrieving information about the projects currently underway are discussed:

1. Organizational Resumé
2. Project Register
3. Project Resumé
4. Project Supporting Documents

A. R&D Organization Resume

The resume for the R&D organization briefly describes the overall purposes of the organization and delimits the major projects which are being conducted. The resume also includes information about the staff of the organization, sources of funding, and other relevant information. The resume, although it is brief, provides an overview of the organization and the projects conducted by staff members. The organizational resume is written to communicate to a wide variety of audiences.

B. Project Register

The project register is a list of the projects currently being conducted by the organization. The project register also includes a unique number for each project and the name of the principal investigator. It is the

key document for identifying the substantive activities conducted by the organization, and is used as an index for locating information about the projects.

In many cases it is possible to arrange the projects listed on the project register into meaningful categories. The categories may be programs, for example: a series of related projects on the same general topic or a category describing types of activity, for example: basic research, development and service. Assigning projects to programs or general categories is of assistance in locating specific projects. In addition, the organization of the projects into programs assists in defining the major programs of the organization.

C. Project Resume

A project refers to identifiable research, development and service activities of the organization. The resume describes what is being done, how the project is being conducted, and the terminal objectives of the project. The project resume provides a brief description of these activities and serves as an operational definition for the activities being performed. The following categories are useful to describe projects and additional ones may be included if more information is required.

1. principal investigator
2. title of the project, address, date initiated
3. key word identifiers
4. purpose
5. method
6. characteristics of the people
7. expected terminal objective and date of completion

D. Project Supporting Documents

Documents which provide additional information about the projects are called project supporting documents. For example, a project proposal supplies information in more detail than the abstract and is used to supplement the project abstract. In the same manner, other written materials may be prepared to describe the curriculum, film, videotapes, and equipment being used. Each one of these descriptive documents provide additional information about the activities being conducted. In some cases the documents may simply describe the events which have occurred. However, in most cases the proposal or written plans for the activity are all that is needed to provide supplemental information about the project.

III. COMPLETED OUTPUTS

R&D organizations complete many reports about the activities which are conducted by the organization. The organization also receives many requests for information about these projects. Accordingly, a system similar to the one for retrieving information about ongoing projects is useful when answering requests about projects which have been completed. The components of the system for organizing information about completed activities of the organization include:

1. report register
2. report abstract
3. final reports
4. product file

A. Report Register

The report register is a list of all the reports which have been completed by the organization. The format of the report register is similar to a bibliography; it provides the author(s), title, publisher, and the date of the document. It is a key document which describes the reports which have been completed by the organization, and is useful as an index for locating information for retrieving publications.

In some cases it is necessary to arrange the report included in the Report Register under different categories for classifying the documents. For example, the report register may be arranged according to program categories specified by the project register. This arrangement of the report supplies information about the reports produced from each program. The report register may also be organized according to general categories which may assist in locating reports requested by other individuals.

B. Report Abstract

An abstract of a report is an effective way of quickly communicating the findings of a study to others. R&D organizations receive many requests for information about the findings of studies that have been completed. The abstract provides a concise and economical means for disseminating information to others. In addition, the abstract allows research managers to organize and present the outputs from specific programs.

The ERIC publication Research in Education as well as other information dissemination systems provide examples of information dense abstracts. The abstracts are short, and contain the essential information included in the report. When preparing an abstract the following categories are used. Additional categories may be added, if needed, but it is

essential that the abstract remain as concise as possible.

1. author(s)
2. title, publisher, date completed
3. key-work identifiers
4. purpose
5. method
6. characteristics of sample
7. findings

C. Publication Library

The reports and other publications of the R&D organization are maintained in a location which permits easy access to copies of the publication. The documents are arranged in a manner similar to a library, and it may be necessary to have a person assigned the responsibility of maintaining the publication library. The person in charge of the library may set up card files, report registers, and other cross-reference documents to assist in retrieving specific reports.

D. Product File

One purpose of development projects is to produce a product which can be used by other people. The term product refers to some type of material object which is produced as a result of an R&D activity. A product includes for example: curriculum materials, electronic equipment, programmed instruction techniques, videotapes, films, etc. An organization may produce many different products, and a system is needed to have information about these products. Accordingly, the model used to organize information about the reports produced by staff members was adopted to handle products. The resume for the product, however, includes different categories of information. These topics are included in the product resume: 1) name of product developer, 2) name of product, 3) purpose of the product, 4) cost and availability of the product, and 5) testing and evaluation data about the product. With the exception of different categories in the resume the following components describe the system for managing information about the products of an organization:

1. Product Register
2. Product Resume
3. Product "Library"

IV. PERSONNEL

Information about the background and abilities of the individual staff members is used often in the preparation of proposals, assignments in

consulting positions, and describing the capabilities of the organization. Accordingly, it is helpful if research managers have information about the staff in a readily available form. This subsystem of the research management system describes several procedures for organizing the information about staff members. The following four components of the system are described.

1. staff register
2. staff vitae
3. staff publication list
4. consultant file

A. Staff Register

The staff register is a list of the names and positions of the members of the organization. It includes all the personnel in the organization, and may be arranged according to categories of positions. The categories for example may be professional, technical and clerical staff members or any other categories which are of assistance when using the staff register as an index for securing additional information about the staff member.

B. Staff Vitae

One of the most frequently used documents in a research organization is the vitae of staff members. A vitae is included in proposals prepared by the R&D organization, in documents describing the capabilities of the organization, and when individuals with specific abilities need to be identified. Because the vitae is used very often, it is helpful if all vitae are in a common concise format, and are in a form which is easily reproduced on a copy machine. A one-page vitae is usually sufficient for most needs for information. Accordingly, the Experience, Consultant, and Publication categories are usually limited to five entries. The following describes categories of information about each person that are included in the vitae

1. Name
2. Position
3. Address and telephone number
4. Specialties
5. Education
6. Experience
7. Consultant Activities
8. Publications

C. Staff Publication List

This list is a bibliography of all the publications of the staff members. A separate list is prepared for each staff member. It is usually prepared

in bibliographic style, e.g., name, title, publisher, and date, and it may include several key-work identifiers about each publication. The key-word identifiers identify the nature of the publication, and are helpful when screening the bibliography of the individual, in order to select appropriate publications to include on the vitae.

D. Consultant File

Consultants are employed to assist staff members in planning, reviewing, and evaluating the projects that are conducted by the organization. The role of an outside consultant is to provide objective and unbiased information to the members of the organization on topics relevant to his experience and background. Accordingly, another component of a research management system is to provide information which assists the members of the organization to select qualified outside consultants.

The system described for organizing information about the staff members of the R&D organization serves as the model for developing the Consultant File. One exception occurs, however, instead of maintaining a file of publications for the person, it is necessary to maintain a file of the reports made by the Consultant. The reports may include the evaluation of specific projects, reports, programs or the entire organization. The following comprises the Consultant File:

1. Consultant Register-Name, address, telephone, etc.
2. Consultant Vitae-Specialties, education, experience, etc.
3. Consultant Report File-Evaluative reports made by the consultant

V. PROPOSAL PREPARATION PROCEDURES

Staff members in R&D organizations prepare many proposals for projects. The proposals for R&D activities are submitted to agencies for funding or to the director of the organization for consideration as a potential new activity. Many new staff members may have never prepared a proposal, and they may not know the instructions and procedures for submitting them to a funding agency. Accordingly, another important component of a research management system is to provide information for preparing proposals to the staff members of the organization. The following are the essential components of this system:

1. Funding Agency File
2. "Ideas-for -Projects" File
3. Proposal File

A. Funding Agency File

The forms, instruction, brochures, and current priorities for projects for appropriate funding agencies are maintained in this file. The file permits staff members to secure information which assists them in preparing a proposal for a specific agency. Maintaining a file or relevant information about the submission of a proposal to an agency obviates the dilemma of not having the forms, etc., when notice of a request for proposal is given. The file is indexed by agency. Additional indexes may be prepared to list agencies which fund specific types of projects. The file may also be used to maintain other publications related sources of funding for example, the publication Business and Daily Commerce.

B. "Ideas-for-Projects" File

The "Ideas-for-Projects" File is used to retain brief descriptions of ideas which may be developed into R&D projects. When a staff member has an idea, a brief resumé is prepared so that the essential elements are worded. One page is usually sufficient to record a title, a description of the idea, and references which provide background information for the idea.

This file is especially useful when there are staff members available to develop the idea. For example, graduate assistants may be used to complete the groundwork needed to formulate a proposal from the brief one-page description. Thus, the file is a source of ideas for individuals who wish to initiate research and development projects.

C. Proposal File

The proposal file contains copies of the proposals submitted by the R&D organization as well as other proposals which may be of assistance to the staff members. The preparation of a research proposal is a time-consuming task, and represents the ideas and work of many individuals. The proposal, even though it may not have been funded, may contain valuable information which may assist staff members of the organization in preparing new proposals. Some portions of proposals remain relatively constant, for example the description of the computer facilities available to the organization, or reviews of the literautre on specific topics. This information with revisions according to events which have occured may be of assistance in preparing a new document.

Another value of a proposal file is that it provides examples of how to write a research proposal to new members of the organization. Thus, the proposal file may assist new people in improving their skills at writing research proposals. In addition, the ideas contained in the proposal may provide the impetus for the development of other projects.

VI. ORGANIZATIONAL REPORTS

R&D staff members prepare reports for describing the activities, accomplishments, and plans of the organization. Typically, the reports are prepared to describe the events occuring in the organization for specified periods of time. Annual reports, for example, are prepared to communicate what happened during the prior year, as quarterly reports on the other hand may only cover events during a three-month period of time. In some organizations it is necessary to prepare a report which describes the plans for the future, This report may project planned activities for the next year or for a longer period of time for example, a five-year period. In short, organizational reports describe the past, relatively recent events, and future plans. The following are the components of an organizational reporting system.

1. Annual Report
2. Progress Reports
3. Program Plans

A. Annual Report

The annual report is the basic document for describing the activities and accomplishments of the organization for the year. The purpose of the report is not only to describe the events of the year, but also to provide the reader with some information about the history and mission of the organization. In other words, the annual report sets the yearly activities in the context of the goals of the organization. The annual report is a document which by and large is sufficient to provide an individual with basic knowledge about the organization. Annual reports are often disseminated widely. Accordingly it is necessary to prepare the document so that it is written using terms that will communicate to the audience that reads it. The following is an outline of topics included in a typical annual report.

1. Staff members of the organization
2. List of projects currently being conducted
3. Brief history of the organization
4. Overview of organizational goals
5. Resumé of major programs or projects
6. Activities and accomplishments for the year
7. Review of major accomplishments
8. Overview of future plans

B. Progress Reports

A progress report provides information about the events which have recently occurred in the organization. Progress reports are published quarterly or semi-annually and are used primarily to update the information contained in other reports. The progress report also allows the

organization to report events of significance more rapidly than if it must wait until the annual report is written. In short, progress reports provide a means for research managers to have current information about organization activities.

One purpose of the progress report is to update the information base which is maintained for the organization. Accordingly, to minimize the amount of information which has already been submitted, a system of reporting by exception is preferable. When the reporting by exception system is used, the report is prepared by including new information when it is needed and reporting "no change" in categories which have remained the same. The progress report is then used to update the basic file on the organization. The following is a list of categories included in a progress report.

1. Overview of organizational goals-update includes new overview
2. Staff Register-update includes vitae for new staff members
3. Organizational chart-update
4. Project Register-update includes resumés for new projects
5. Report Register update-includes abstracts of completed reports
6. Dissemination activities
   a. workshops, conferences, etc., sponsored
   b. newspaper releases, lectures, reports, etc.

C. Program Plan

The program plan describes the long-term objectives of the R&D organization, and the new projects which will be initiated by staff members. The program plan includes detailed proposals for the projects which have been selected to become a part of the ongoing activities of the organization.

The Program Plan is written after "inhouse" sessions have been conducted to review all proposals for new projects. The program plan then serves as the basis for guiding the plans of the organization during the next period of time. In addition, the program plan also provides input to "inhouse" sessions, for planning the long-term objectives of the organization.

VII. EVALUATION REPORTS

Another component of the Prototypic Research Management System refers to evaluation reports describing the R&D organization and the projects that are conducted by staff members. Although few systematic and objective methods have been developed to evaluate organizations and projects, evaluations are constantly being conducted. In this section, the

system for organizing information is described, and a form for evaluating research reports is presented.

A. Report Evaluation Form

The purpose of the Report Evaluation Form is to obtain ratings from qualified outside consultants about the "quality" of a research report. The form was constructed primarily as a means of securing descriptive information about specific categories which are commonly related to evaluation. The categories are general enough to be used for rating different types of projects. Gephart also has constructed an excellant evaluation form which thoroughly covers the design and statistical aspects of research projects[2] as well as other categories of information relevant to evaluation.

The Report Evaluation Form was administered to 53 persons who completed the form on a research report. The evaluators had training in the topic of the study that they evaluated. A factor analysis of the items in the Report Evaluation Form was conducted to determine if the items obtained high loadings on the constructs measured by the instrument. The results of Table I indicate that the items in each category do fall out on the same factors. Accordingly, it was concluded that the instrument does measure the following attributes of a research report.

1. Significance to Education
2. Conceptualization of the Problem
3. Methodology and Design of the Study
4. Interpretation of the Results
5. Usefulness of the Report

Subtest scores for each of these categories may be obtained by computing factor scores for the instrument or summing the responses to each item in the subtest after reverse scoring the appropriate items. A copy of the Report Evaluation Form is included in the Appendix.

B. Evaluation File

R&D organizations receive site visits for evaluating the projects and operations of the organization. The site visitors usually prepare a written document which reports their observations about the visit. The report that is prepared provides feedback to the staff members of the organization, and provides additional input to the decision-making process. The Evaluation File allows research managers to maintain the reports written by site visitors, and use these reports to prepare summaries of the findings of the

[2] Gephart, William J., "Development of an Instrument for Evaluating Educational Research Reports," Cooperative Research Project No. S-014, University of Wisconsin - Milwaukee, Milwaukee, Wisconsin, 1964

TABLE I
VARIMAX ROTATED FACTOR LOADINGS FOR THE
RESEARCH REPORT EVALUATION FORM
(N=53)

Item No.	Factor Loadings I	II	III	IV	V	h^2	Item
							II Significance
1	01	84	24	00	13	78	an important problem
2	15	84	-03	32	05	84	additional study needed
3	06	89	-03	17	03	83	high priority topic
4	07	65	19	-20	23	55	relevant to broad segment
5	00	81	33	02	11	78	high potential value
							V Conceptualization
6	11	35	19	25	58	57	established a problem
7	-01	04	16	06	59	38	based upon prior research
8	-02	18	33	31	65	67	related to theory
9	29	03	12	00	73	64	objectives identified clearly
10	42	11	-04	-07	75	76	variables defined operationally
11	38	38	-18	23	46	59	variables relevant to problem
							I Method & Design
12	81	14	-01	-06	23	74	controls for confounding
13	83	00	-04	03	15	72	statistics appropriate
14	72	06	35	-41	11	83	can replicate study
15	83	13	02	-03	24	76	reliable and valid data
16	75	-02	02	29	05	65	confounding effects identified
17	76	-04	24	-22	21	73	assumption not violated
18	70	13	22	31	06	65	inferences warranted
19	84	05	17	26	-04	81	inferences & opinion separated
							III Interpretation
20	53	20	58	03	05	67	findings stated clearly
21	-01	21	76	20	08	54	closed a gap in knowledge
22	28	16	76	12	28	81	objectives of study fulfilled
23	41	-02	61	30	42	59	most important results identified
24	-03	-39	63	17	35	78	important contribution
							IV Usefulness
25	25	02	24	68	-08	81	interpretations are referenced
26	29	11	24	21	47	71	describes use of findings
27	24	52	10	55	21	42	impetus for additional studies
28	-10	16	02	66	27	69	identified new variables
29	-01	01	26	63	25	53	clarified prior findings
	9.5	4.2	2.4	1.9	1.7		Eigenvalue
	33	47	55	62	68		% Variance

site visitors. Although the evaluative reports prepared by site visitors do not usually follow a common format, the following categories of information may be rated by site visitors.

1. Significance of the research topics
2. Sophistication of research design and methodology
3. Sophistication of development activities
4. Effectiveness of dissemination activities
5. Balance and integration of the R&D activities
6. Economic efficiency of the organization
7. Effectiveness of Institutional Relationships
8. Quality of Personnel
9. Program Planning and Evaluation Procedures
10. Management of the Organization

OVERVIEW

The research management system which has been described in this paper was designed primarily as a manually operated system. The reason for this is, of course, that many R&D organizations do not have computer systems which can be used to perform many of the retrieval and updating operations. Nevertheless, the system which has been described may be converted to a computerized system. The conversion of a manual system to a computerized one is much easier and less expensive when the information has been recorded in a common format. This system puts the information in a common format.

One procedure which was not discussed in the paper is the maintenance of an updated looseleaf notebook containing the information used most often by research managers. In the notebook the latest abstracts, resumes, and vitas of the projects and personnel are maintained. In addition, the registers for these documents are also included in the notebook. The information supplied in the progress report is used to update the notebook, and thus current descriptive information about the R&D organization is at hand.

In summary, the Prototypic Research Management System provides one way of managing information about R&D organizations. Admittedly, it is not a final system, but at least it is a start towards improved research management.

One final note, for the researcher his terminal product is usually a research report of some type which serves to communicate his work, findings, and conclusions along with other descriptive information. The utility of his work is dependent on many factors and the following Research Report Evaluation Form offers some questions which can assist both researchers in the design and evaluation of their projects as well as consumers of the research to relate the product to their needs in realistic ways.

Research Report Evaluation Form

Don B. Croft
New Mexico State University

This form is used for evaluating research reports and was designed to obtain ratings and written comments about selected attributes of a final report. The attributes that have been selected include some of the criteria used for evaluating research projects. The completed Research Report Evaluation Form provides information from education specialists for evaluating the quality of a report and is not the only source of evaluative information about a project. Please consider your comments and rating carefully in order to provide accurate and useful information about your evaluation of the report.

The form is used to rate many different types of final reports. When an item is not relevant for a specific type of study, please circle NR. When you are not able to make a rating based upon your knowledge about a specific item, please circle NI. However, if at all possible please attempt to answer every item, making careful estimates when it is necessary. Please write your comments in a brief and concise manner covering the salient points which you wish to make. You may include references to other studies in order to provide us with additional information.

Please complete the following:

Title of Report_____

Author of Report_____

Evaluator_____

Date_____

NR - Not relevant
DK - Don't know
NI - No information

1. Strongly disagree
2. Disagree
3. Agree
4. Strongly agree

A. Significance to education

1. The topic of study is relevant to an important education problem. 1 2 3 4 NR DK NI

2. A need existed for additional study on this topic. 1 2 3 4 NR DK NI

3. A high priority currently exists for studies on this topic. 1 2 3 4 NR DK NI

4. The topic has relevance to a broad segment of educators. 1 2 3 4 NR DK NI

5. Findings on this topic have high potential value to educational knowledge or practice. 1 2 3 4 NR DK NI

Please describe the value and significance of this topic of study to educational knowledge or practice.

NR-Not relevant
DK-Don't know
NI-No information

1. Strongly disagree
2. Disagree
3. Agree
4. Strongly agree

B. Conceptualization of the Problem

1. The report establishes the existence of a problem. 1 2 3 4 NR DK NI

2. The study is based upon salient prior research studies. 1 2 3 4 NR DK NI

3. The relationship of the problem to theory or practice is clearly stated. 1 2 3 4 NR DK NI

4. The objectives of the study are identified and described clearly. 1 2 3 4 NR DK NI

5. The variables and terms are defined operationally. 1 2 3 4 NR DK NI

6. The variables identified are relevant to the problem. 1 2 3 4 NR DK NI

Please describe how well the investigators conceptualized the problem area and selected variables relevant to the problem.

NR-not relevant
DK-Don't Know
NI -No information

1. Strongly disagee
2. Disagree
3. Agree
4. Strongly agree

C. Methodology and Design of the Study

1. The design of the study controls for important confounding effects. 1 2 3 4 NR DK NI

2. The statistical analysis was appropriate for the data. 1 2 3 4 NR DK NI

3. The report provides information for replicating the study. 1 2 3 4 NR DK NI

4. The data were collected by reliable and valid procedures. 1 2 3 4 NR DK NI

5. Effects which may have confounded the results are identified. 1 2 3 4 NR DK NI

6. Assumptions underlying the statistical methods were not violated. 1 2 3 4 NR DK NI

7. The inferences made from the data analyses are warranted. 1 2 3 4 NR DK NI

8. Inferences from the data and the opinions of the investigator are separated clearly. 1 2 3 4 NR DK NI

Please describe the appropriateness of the design or methods used in this study.

NR - Not relevant
DK - Don't know
NI - No information

1. Strongly disagree
2. Disagree
3. Agree
4. Strongly agree

D. Interpretation of results

1. The findings of the study are stated clearly. 1 2 3 4 NR DK NI

2. The objectives of the study were fulfilled. 1 2 3 4 NR DK NI

3. The most important results were identified and interpreted. 1 2 3 4 NR DK NI

4. The report is an important contribution to knowledge in the field. 1 2 3 4 NR DK NI

5. The report helps close an important gap in current knowledge. 1 2 3 4 NR DK NI

Please describe how well the investigator interpreted the results of the analysis.

NR - Not relevant
DK - Don't know
NI - No information

1. Strongly disagree
2. Disagree
3. Agree
4. Strongly agree

E. Usefulness of the report

1. Interpretations are supported by references to other studies. 1 2 3 4 NR DK NI

2. The report describes the usefulness of the findings. 1 2 3 4 NR DK NI

3. The report provides the impetus for additional studies. 1 2 3 4 NR DK NI

4. The report identifies new variables relevant to the problem. 1 2 3 4 NR DK NI

5. The report clarifies the findings of prior studies. 1 2 3 4 NR DK NI

Please describe how useful this report is to educational knowledge or practice.

AN OPERATIONS MANUAL FOR RESEARCH ORGANIZATIONS

Dan G. Woolpert[1]

The Wisconsin Research and Development Center for Cognitive Learning is a somewhat unique organization at the University of Wisconsin. In many ways it seems to sit astraddle the academic/business divide with a foot in each camp. The Center is a part of the University of Wisconsin. Its staff are employees of the University of Wisconsin. They enjoy and expect the working conditions and generally unfettered environment that is typical of faculty status. On the other hand the level of accountability required by the Center's heavy use of federal funds requires operational procedures similar to those commonly employed by independent profit and non-profit institutions.

It was out of this context that the Center elected to pull together a number of Office of Education, State, University and Center policies and procedures into a Handbook. The most recent version is the fourth revision. It was current for the 1969-70 academic year. While much of the content is relevant only to the Wisconsin Center, other similar organizations may be able to utilize the Handbook as a model for operations manuals of their own.

A basic choice that was made was to be inclusive rather than exclusive as the Handbook was put together. It is a reference volume. The Center staff is not expected to read the Handbook cover to cover and be familiar with all of the material presented. They are expected to have one available and to be familiar with its organization so that they can identify relevant materials when needed. It is a problem solving resource. In this regard a complete and accurate index is absolutely critical.

The Handbook as it now stands includes everything from the Office of Education rationale for establishing Center's to how to use the "hold" button on the telephone. Both seem appropriate and useful inclusions. Staff rosters and committee lists however are questionable inclusions. They are invariably dated. On the other hand, they are more readily accessible in the Handbook than on separate, easily misplaced sheets. The

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material included in the fourth version by chapter is:

I. The CCL: ITS NATIONAL CONTEXT AND LEGAL COMMITMENTS- Relates the Center to the larger framework of national educational research and development and indicates some of the legal constraints of federal contracting.

II. THE CENTER'S GOVERNING AND ADVISORY GROUPS - Relates the Center to Federal, State and University institutions and describes the internal governance of the Center.

III. PERSONNEL POLICIES AND POSITIONS - Describes the conditions of employment for the various levels of Center Staff.

IV. PROGRAM PLANNING AND BUDGETING - Describes the program planning/budgeting process used by the Center.

V. RESEARCH AND DEVELOPMENT PROGRAM SUMMARY - Very briefly describes the programmatic structure and thrust of the Center.

VI. THE TECHNICAL DEVELOPMENT PROGRAM - Describes the functions of the Center's Technical Section and indicates procedures and constraints concerning the use of its resources. Describes in detail how to relate to cooperating schools.

VII. THE DISSEMINATION PROGRAM - Describes the functions of the Center's Dissemination Section and indicates procedures and constraints concerning the use of its resources. Describes in detail Center documents and their use.

VIII. OTHER DISSEMINATION ACTIVITIES GUIDELINES - Describes in detail how to acquire the resources needed to carry out project activities. Describes administrative services.

Committees and Staff - Lists all persons related to the Center as of the date of publication.

Forms and Outlines - Provides samples of the procedural forms needed to function efficiently within the Center structure.

Each new employee is given a copy of the Handbook at the time of

employment. About four times each year representatives of each of the Center's service sections meet with new employees to highlight important procedural statements and other situations that are traditionally trouble - some. The most common use of the Handbook following orientation is by staff to identify procedures. The Handbook is also obviously useful as a control device and is not infrequently used to settle disputes. In it, policy statements are documented and easily accessible. The most useful ele - ments seem to be the "how to " statements of Center and University procedures.

The detailed procedures and forms included in operational handbooks make visible a degree of bureaucracy that is unpalatable to many in the University environment. The Wisconsin Center has found, however, that to the extent that a handbook can simplify and facilitiate an individual's work it will be well received.

The following pages are illustrative of the scope and content of the Handbook and include a copy of its "Table of Contents" and from its "Appendix" the "List of Forms and Outlines", the "Prospectus for A Research Report", and the "Prospectus for A Development Project".

Wisconsin R&D Center For Cognitive Learning Handbook

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Prospectus for a Research Project

This prospectus is prepared by the Principal Investigator for the initiation of any new project and also for the annual program planning and budgeting of each continuing project. The headings are intended to be applicable to all Center projects, whether the major effort is research with a lesser development effort or vice versa. The Center Director and other members of the Management Council will provide relevant information and assist in preparation of the Project Prospectus so that program planning and budgeting procedures of the Center are implemented.

I.. Title of Project

II. Name(s) of Principal Investigator(s)

List also full-time employees or others affiliated with the project and their specific responsiblities.

III. Statement of general objectives

These objectives are stated in accordance with the Program objectives and in a similar form.

IV. Importance, need, or justification

Only a summary is necessary for continuing projects. For new projects this section should contain a concise description of the educational situation requiring change or the problem requiring research. The status of present knowledge and the anticipated contribution of the projected research should be indicated.

V. Strategy or operational plans

This part is the nucleus of the prospectus, for both a new and a continuing project. It should describe the operations that will be performed in pursuing a research question or line of inquiry. The sequence of activities, and the specific interim and terminal outputs should be stated in terms of Center publications.

VI. Target population or experimental subjects

The characteristics of the experimental subjects should be described as fully as possible, as well as the ultimate target population for which the research findings will have value.

VII. Expected end products or results

A statement of end products or results by quarter for the next fiscal year and by year for the next five years should be indicated in terms of substance incorporated in Center publications.

The information would be stated something as follows:

FY 70

April--Technical Report: New knowledge related to motivation and retention.
July--Working Paper: First draft of synthesis of research on motivation.
October--Two Technical Reports: New knowledge related to the semantic components of concept learning.
January--Working Paper: Pilot studies related to acquisition of literacy.

FY 71

Five Technical Reports: New knowledge related to the effects of situational variables on concept learning.

FY 72

Theoretical Paper: A theory of creative thinking.

FY 73

Six Technical Reports: New knowledge related to learning and social conformity.

FY 74

Working Paper: A preliminary statement related to the structure of concept attainment abilities.

The above types of statements might well follow a brief introductory paragraph which generally describes the line or lines of inquiry one is pursuing in a research project. End results or products should show a progression of activities over time toward a refined theory. Finally, activities should properly reflect the funding level of the project--the larger the project, generally, the more results or end products would be described.

VIII. Relation of this project to other projects

Relationships should be stated in terms of the substantive area, the general objective, the strategies, personnel, and substantive results or outputs. Each principal investigator should be thoroughly familiar with all other projects of the same Program and with any project of similar concern in other Programs.

IX. Time schedule

A projected time schedule should be indicated on the Time Schedule attached to this form. (See Form 204)

X. Personnel and budget requirements

Indicate on the attached budget form:

1. The proportion of the principal investigator's time which will be committed to this project.
2. The number and types of supporting personnel which will be needed (excluding secretarial and clerical staff).
3. Activities that may require expenditures above $250 for supplies, equipment, or services. The staff in the Operations and Business Section are available for help in estimating costs.

Prospectus for a Development Project

This prospectus is prepared by the Principal Investigator for the initiation of any new project and also for the program planning and budgeting of each continuing project. The headings are intended to be applicable to all Center projects, whether the major effort is development with a lesser research effort or vice versa. The Center Director and other members of the Management Council will provide relevant information and assist in preparation of the Project Prospectus so that program planning and budgeting procedures of the Center are implemented.

I. Title of project

II. Name(s) of Principal Investigator(s)

List also full-time employees or others affiliated with the project and their specific responsibilities for the development or the related development-based research.

III. Statement of general objectives

These objectives are stated in accordance with the Program objectives and in a similar form.

IV. Importance, need, or justification

An analysis of the present elementary school situation is given with an indication of the need that the proposed development is to alleviate. The need this development activity is trying to satisfy is clearly specified. In turn, this gives a first approximation of the type of product and the target population or populations; e.g. materials for use by students and related instructional guides for teachers.

Deficiencies in the present situation should be outlined, and the status of the target population upon completion of the project should be indicated:

a. What the individuals in the target population will be doing when they have achieved the objectives.
b. Under what conditions they will be doing it.
c. How well they will be doing it.

V. Strategy or operational plans

The sequential operations that will be performed in developing, testing, and revising, the product(s) are outlines. In general these operations include

a. A statement of the specific objectives of the product(s) in terms of pupil behaviors, teacher behaviors, or both depending on the nature of the product.
b. The "real world" constraints in which the proposed product must operate.
c. A set of specifications of products, alternatives perhaps, in terms of (l) types, e.g. printed, audiovisual: (2) length or amount of materials ; (3) use of the product, e.g. independent study, small group discussions, large group information receiving; (4) amount and type of assistance required for practitioners to make the product operative.
d. The product development - formative evaluation - revision sequence.
e. The large-scale field test by the Center or other agency and the summative evaluation.
f. Procedures for dissemination by Center and installation and further field test by other agency.

These developmental steps are explicated in "Guidelines for Quality Verification of Materials Developed at the Center for Pupils and Educators".

VI. Target population

The characteristics of the target population for the intended instructional material should be described as fully as possible.

VII. Expected end products or results

A statement of end products or results by quarter for the next fiscal year and by year for the next five years should be indicated in terms of substance incorporated in Center publications.

The information would be stated something as follows:

FY 70

April--Working Paper: A second version of a teacher's manual

for kindergarten and early primary teachers.

July--Working Paper: A pilot version of individual diagnostic or assessment tests.

October--Technical Report: Results of pilot testing the second version of a teacher's manual for kindergarten and early primary grades.

January--Theoretical Paper: A taxonomy of behavioral objectives for kindergarten and early primary levels.

FY 71

Materials: Additional system components including video tapes and printed inservice materials (reported in a Practical Paper) for teachers, kindergarten and early primary levels.

FY 72

Technical Report: Results of field tests for materials for kindergarten and early primary levels.

FY 73

Working Paper: A first version of materials for later primary levels.
Technical Report: Pilot test results.

FY 74

Practical Papers: The second version of materials for later primary levels.
Technical Report: Results of field tests.

The above types of statements might well follow a brief introductory paragraph which generally describes the nature of the system under development. End results or products should show a progression of activities over time toward the development of an instructional system. Finally, activities should properly reflect the funding level of the project--the larger the project, generally, the more results or end products should be described.

VIII. Relation of this project to other Center projects

Relationships should be stated in terms of the substantive area, the general objectives, the strategies, personnel, and outputs. Each Principal Investigator should be thoroughly familiar with all other projects of the same Program and with any project of similar concern in each other Program.

IX. Time schedule

A projected time schedule should be indicated on the Time Schedule attached to this form. (See form 204)

X. Personnel and budget requirements

Indicate on the attached budget form:

1. the proportion of the Principal Investigator's time which will be committed to this project

2. the number and types of supporting personnel which will be needed (excluding secretarial and clerical staff)

3. activities that may require expenditures above $250 for supplies, equipment, or services. The staff in the Operations and Business Section are available for help in estimating costs.

MANAGEMENT INFORMATION SYSTEMS FOR THE EDUCATIONAL RESEARCHER[1]

John F. Vinsonhaler and Stuart W. Thomas

Thomas A. Edison once complained that "Genius is one per cent inspiration and ninety-nine per cent perspiration." Unfortunately, the statement is all too true for the activities of the university scientist. As the modern scientific researcher fills his various roles -- as author, experimenter, and administrator--much of his energy is spent on tasks which make little use of his scientific abilities. The present paper concerns the use of computers to shift the scientist's distribution of effort from perspiration toward inspiration.

Generalized Management Information Systems for Researchers.

Over the past ten years, computer scientists have directed their attention to the various isolated activities of the modern research scientist. Automated systems have been offered for specialized literature searching (Kent, 1965), for statistical data analysis (Cooley and Lohnes, 1962), for data sharing (Bisco, 1970), and even for data collection (Uttal, 1968). What has not been considered is the total activities of the researcher, i.e., the need for generalized systems to support the combined activities of the modern scientist.

The key concept is the Management Information System (MIS) presently used in administration (Weiss, 1970). "An MIS may be defined as a system that makes any information in the data base (files) immediately available to the user, to satisfy his planned, as well as unplanned information requirements."

II. MANAGEMENT INFORMATION SYSTEMS

There are two aspects to the MIS approach. First, an integrated file is prepared including all data necessary for the user's information needs. Second, a general purpose file management system is used to maintain files and generate reports.

---

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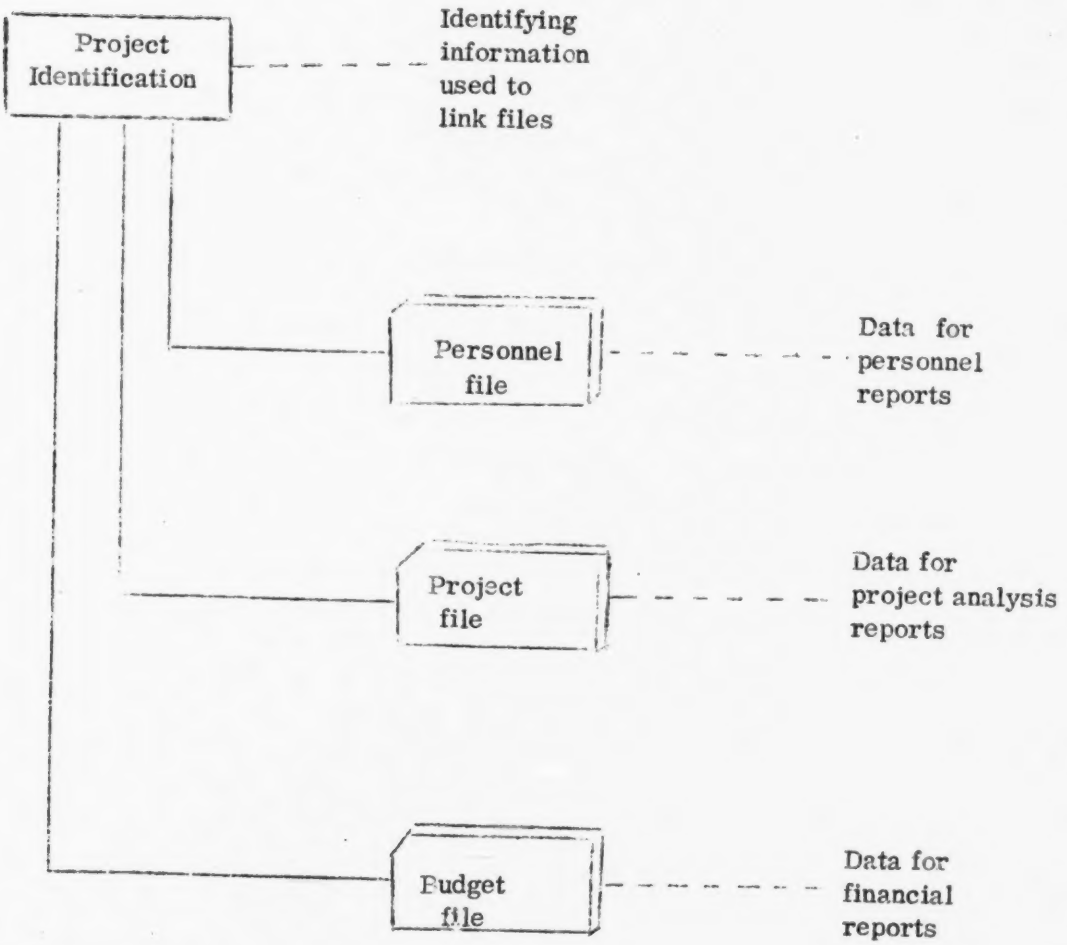
A. Integrated Data Files.

The creation of separate reports for various management purposes requires the integration of many types of information, as illustrated in the following figure. As shown, the MIS user must create a universal file of linked data records.

The integrated data file is capable of two types of reports--those generated from separate files and those generated by combining separate files--e.g., combining personnel and budget data. The integration or common link permits the preparation of reports for unanticipated information needs. There are many methods of forming links. The common identification or label is the one illustrated. Records are integrated by selecting those with common labels. A more general method is the use of a common index to the contents of all files (Meadow, 1967;pp. 226-252).

FIGURE 1. Integrated Data File.

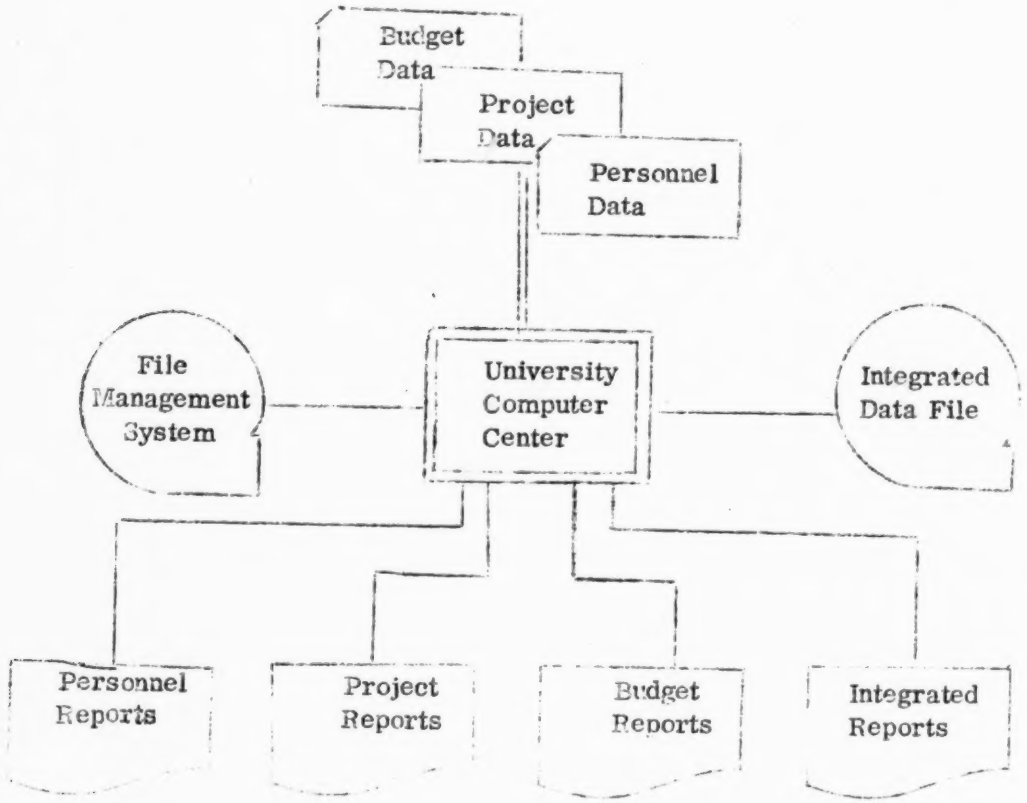


B. File Management.

The second aspect of the MIS approach is the use of generalized file management facilities required to produce both anticipated and unanticipated reports (Aron, 1961). The generalized file management system is a set of computer programs which will produce many different types of reports depending on the files and report descriptions submitted. Such systems are widely available and are periodically reviewed in the computer science literature (see Olle, 1969; Benko, 1969; and Meadow and Meadow, 1970). The use of a generalized file management system increases the flexibility of the MIS, since one need not describe reports to be generated before implementing the system.

The following figure shows the complete MIS concept for research projects as typically implemented in a university environment.

FIGURE 2. The File Management System



The university environment dictates some special MIS characteristics. Very few research projects include budgets for preparing management reports, let alone funds for computers or computer programs. Hence, the research must use locally available facilities. The most practical solution for most scientists is to use the university's computing center. Programming is necessary since general purpose file management systems are available for nearly all major computers. (Meadow and Meadow, 1970)

In summary, this is the MIS solution to the research management problems -- creating a generalized data file from aggregate data records and then generating the required reports from the file by using file management software available on the scientist's own computer.

Now let us consider a case study of this general technique as applied to financial record management.

III. MISR: A CASE STUDY

The present authors have developed a representative MIS for researchers to provide accounting reports for two research projects funded by grants and contracts from the U.S. Office of Education. Their projects accounting procedures related expenditures to research objectives. However, reconciliation of the project accounting with reports prepared by the university business office required reclassification of many expenditures, and furthermore, financial reports for the USOE differed from both the university reports and the accounting classification useful for the project. Faced with preparing separate reports for the grantor and for the university, the authors implemented an MIS to maintain integrated files and generate all reports with the CDC 3600 computer at Michigan State University.

The case study assumes no unusual computer capabilities which might prove to be unavailable to the average university researcher. The computer facilities used by the authors' MIS are limited to batch processing with one day turn-around. Further, the file management system used in the project, the Basic Information Retrieval System (BIRS), is available at cost to any university researcher and may be modified for installation on most computers. (BIRS is written in standard USASI Fortran, with dialects for IBM, CDC, etc. See Vinsonhaler, Halterson, and Thomas, 1970.)

Now let us turn to the case study. To begin with, consider the overall design of MISR in relation to the existing university accounting system.

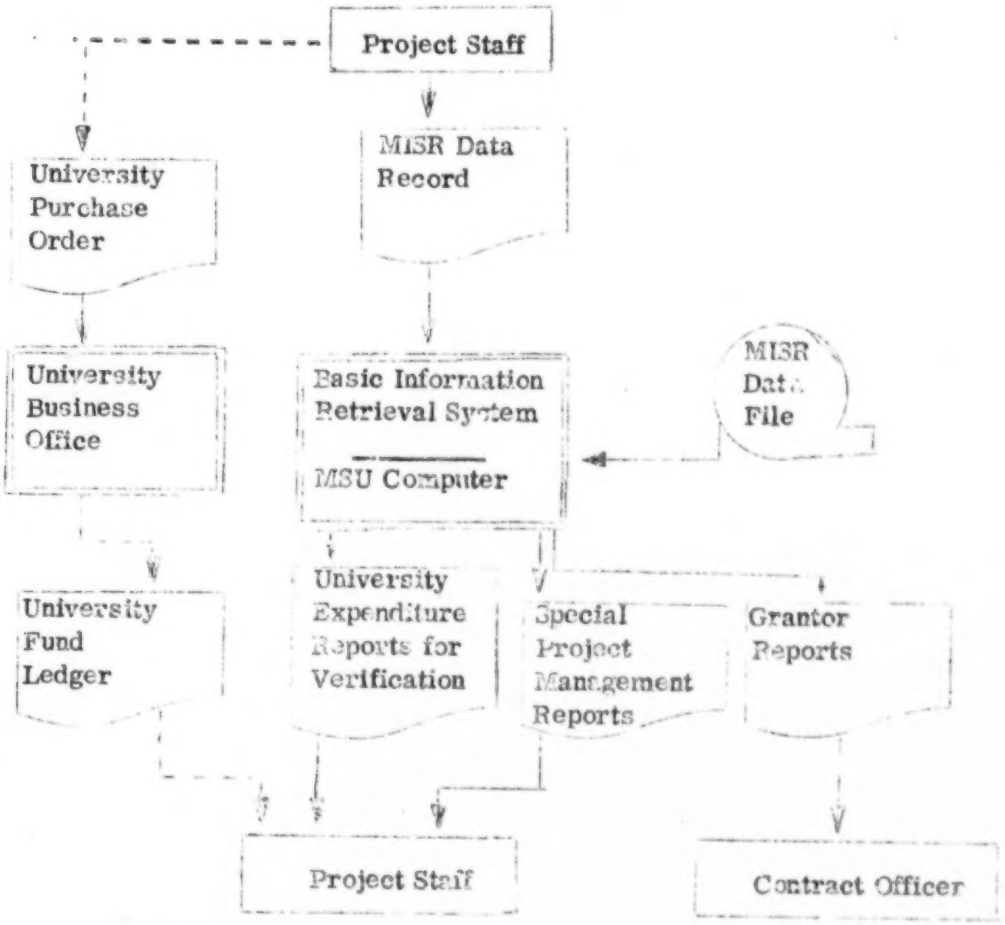
A. General Design.

The following figure summarizes the overall structure of the MISR used at Michigan State University. A distinction is drawn between the university accounting and the MISR operations.

The MISR at MSU operates in parallel with the university accounting procedure (shown on the left in the figure). The university reports are generated mainly to verify the MISR data records and to establish accurate university categorizations of all expenditures.

At MSU, costs appear in university records only after funds have been legally expended. For this reason, the MISR university and grantor reports include only expended funds. Project reports include both expended and committed funds.

FIGURE 3. The MISR Case Study at Michigan State University



B. Input

Input to the MISR/MSU system consists of the integrated data record which combines the basic accounting categories of MSU, the USOF, and the BIRS Project. A sample data record is illustrated in the following figure.

FIGURE 4. MISR Data Record for a Typical Research Project at Michigan State University

MISR DATA FORM

≠D 70 02 26 (date) ≠Salary - JD (item) ≠C $500.00 (cost) ≠A 71-2122 (account)

≠UC (University Category - insert dollar amount)2

010-Pers =$_____
011-TIAA =$_____
012-Soc-Sec =$_____
020-Trav-in-St =$_____
022-Trav-out-St =$_____
030-Trans =$_____
040-Comm =$_____
052-Rent =$_____
061-Print =$_____
062-Bind =$_____
070-Phys-Pl =$_____
072-Honor =$_____
073-Indir-co =$_____
082-Supplies =$_____
090=Equip =$_____
180-Books =$_____

≠PC (Project Category - insert dollar amou)

Admin =$_____
Sys-Mod =$_____
Sys-Stor =$_____
Sys-Proc =$_____
Comp-Char =$_____
Inst =$_____
360-CWU =$_____
360-MSU =$_____
3600-MSU =$_____
3500-MSU =$_____
Other =$_____

≠FC-OE-BE (Federal Category- insert dollar amount)

Sal =$_____
Emp-Ben =$_____
Trav =$_____
Sup-Mat =$_____
Comm =$_____
Sup- epro =$_____
Stat =$_____
Test =$_____
Oth-Serv =$_____
Fin- eport =$_____
Equip. =$_____
Other =$_____
Indir-co =$_____

≠SC (Special Category)

( ) Encumbered

( ) Expended

MISR DATA FORM AFTER KEYPUNCHING

≠D 700226 ≠1 SALARY -JD ≠C $500.00 ≠A 71-2122
≠UC 010-PERS=$500.00 ≠PC SYS-DOC=$500.00 ≠FC-OE-BE SAL=$500.00
≠SC EXP

C. Grantor Reports

The next figure illustrates the type of report generated by MIBR for the grantor, the U.S. Office of Education, Bureau of Education for the Handicapped, using the grantor categories (as specified in the FC-OE-BR field of the data record) to display cumulative totals of expenditures. Since the MIBR technique allows complete freedom in categorization, different reports may be generated for different funding agencies.

FIGURE 5. GRANTOR REPORT: Expenditures by Grantor Category and by Account Charged.

```
**********************************************************************
* TABLE---GRANTOR REPORT                                             *
* DATA---- COST                                                      *
* ROWS---- SAL, EMP-BEN, TRAV, SUP-MAT, COMM, SUP-REPRO, STAT, TEST  *
*          OTH-SERV, FIN-REPORT, EQUIP, OTHER, INDIR-CO              *
* COLUMNS - 71-2122, 71-2140                                         *
*--------------------------------------------------------------------*
* SECTION  1 of      1 SECTION(S)                  PAGE 1            *
*--------------------------------------------------------------------*
*
*                 71-2122          71-2140
*
* SAL             2207.59          1780.56
* EMP-BEN            0.00             0.00
* TRAV             236.60             0.00
* SUP-MAT          389.10           556.70
* COMM               0.00             0.00
* SUP-REPRO          0.00             0.00
* STAT               0.00             0.00
* TEST               0.00             0.00
* OTH-SERV           0.00           562.99
* FIN-REPORT         0.00             0.00
* EQUIP              0.00             0.00
* OTHER              0.00             0.00
* INDIR-CO           0.00             0.00
*
**********************************************************************
```

D. Project Reports

The following figure shows a type of report frequently requested by project administrators. The report documents the manner in which federal funds have been expended to meet specific project objectives. This is accomplished by having expenditures distributed both by project categories (as specified in the FPC field) and by the grantor categories (as specified in the FC-OE-BR field). This type of report provides a sort of "monetary translator" which indicates how funds are expended both from the point of view of the grantor and the project director.

FIGURE 6. PROJECT REPORTS: Total Expenditures Distributed by Project Categories and Federal Categories.

TABLE---PROJECT REPORT
DATA---- COST
ROWS---- SAL, EMP-BEN, TRAV, SUP-MAT, COMM, DUP-REPRO, STAT, TEST, OTH-SERV, FIN-REPORT, EQUIP, OTHER, INDIR-CO
COLUMNS-ADMIN, SYS-MOD, SYS-DOC, SYS-STOR, TOTAL

SECTION 1 OF 1 SECTION(S) PAGE 1

	ADMIN	SYS-MOD	SYS-DOC	SYS-STOR	TOTAL
SAL	1397.44	1753.71	500.00	337.00	3988.15
EMP-BEN	0.00	0.00	0.00	0.00	0.00
TRAV	0.00	236.60	0.00	0.00	236.60
SUP-MAT	445.80	0.00	0.00	540.00	985.80
COMM	0.00	0.00	0.00	0.00	0.00
DUP-REPRO	0.00	0.00	0.00	0.00	0.00
STAT	0.00	0.00	0.00	0.00	0.00
TEST	0.00	0.00	0.00	0.00	0.00
OTH-SERV	562.99	0.00	0.00	0.00	562.99
FIN-REPORT	0.00	0.00	0.00	0.00	0.00
EQUIP	0.00	0.00	0.00	0.00	0.00
OTHER	0.00	0.00	0.00	0.00	0.00
INDIR-CO	0.00	0.00	0.00	0.00	0.00

E. Cost Analysis .

Although the authors kept careful records, the actual costs of MISR are only estimates. The problems are that project secretaries work periodically on MISR -- hence, personnel costs must be estimated; cost parameters such as number of records processed vary monthly; and finally, computer time and keypunch rental reflect current hardware costs at Michigan State University.

In general, costs for the MISR case study appear to be very low. During the eight months of development, a total of 525 transactions were processed at a total cost of $1400 including salary and computer time, or about $2.67 per record. During the last two months of operation, a total of 140 transactions were processed at a cost of $174, or about $1.24 per record. In terms of total project budget, development costs were about 1.7% and operational costs about 0.9%. This per record cost is about half that of preparing and mailing a single business letter.

IV. CONCLUSIONS AND DISCUSSION

Several comments may be offered from our experience with the MISR technique for research project administration.

A. Possible Applications of the MISR Procedures.

The particular MIS procedure used in our case study could probably be applied at any major university by most funded research projects. All that would be required is the modification of the MISR data record to suit the needs of the researcher's university, funding agency, and project objectives. The researcher could either obtain the required computer programs from his local computer or he could obtain a copy of the BIRS system from the authors.

Further, the MISR procedures might also be applied by administrators of academic departments and small research institutes. Again, the problem is simply to modify the MISR data record format for the administrator's special requirements. In short, it would appear that MISR may have many useful applications.

B. Possible Application of the MIS Proecdure:

The MIS technique is based on two concepts: integrated data files and generalized computer programs. Integrated data files are required to permit the preparation of reports requiring a combination of several types of data. The file integration technique used in the present system is to prepare an integrated data record which includes fields for common information and for special information unique to the needs of those sharing the data file.

General purpose software for file management is required in order to use local computers and to prepare the diverse types of reports required by the MIS users. The MIS procedure is made economical through the wide availability of generalized, machine independent computer programs for information storage and report generation. The MIS technique has many potential uses.

In addition to assisting the research in his administrative and scholarly roles, a sufficiently flexible MIS could serve directly in his research activities. In the experience of the authors, a very useful application would require the system to store the researcher's data as he collects it, along with such information as the experimental units or subjects, the variables which were measured, the measuring instruments, date of collection and grant numbers, etc.

One benefit of such a facility is that it would permit the researcher to automate data preparation for computer-aided data analysis. He can select subsets of data for a given experiment; join data (or subsets) from several experiments, do simple transformations and data collapses, etc., without having to sort, merge, or repunch data cards, and without having to preprocess data in transformation routines prior to submitting it for analysis. Furthermore, some software systems have provision for incorporating data analysis programs within themselves -- as is the case with the BIRS system used by the authors (Vinsonhaler, Hafterson, Thomas; 1970: see Volume VII -- Information Retrieval and Report Generation).

Another interesting use of the MIS Technique would be in managing research documents and materials. Thus, the researcher could use the MIS to maintain files of related projects, and relevant documents and to produce needed reports -- such as bibliographies and lists of references. Similarly, the MIS could be used to store stimulus materials and to

generate materials required for research. A few researchers have reportedly used computers for both document and test item storage (e.g., see Silberman and Filep, 1968). The MIS technique might provide a practical method of extending this computer research assistance.

In the present paper, we described a practical MIS to support the scientist in his role as administrator-manager. Hopefully our study will stimulate research on information systems which will assist the scientist with other major aspects of his professional life. We all know that the computer can be a helpful data processor. Perhaps techniques like the MIS approach will now show us practical ways of making the computer our all purpose research assistant.

V. REFERENCES

1. Aron, J.D. "Information Systems in Perspective." ACM Computing Surveys. Vol. 1, No. 4, pp. 213-236, 1969.

2. Beck, E.M. (Editor). Bartlett's Familiar Quotations. Fourteenth Edition. Little-Brown, 1968.

3. Bisco, R.L. (Editor). Data Bases, Computers, and the Social Sciences. Wiley and Sons, Inc., 1970.

4. Cooley, W.W. and Lohnes, P.R. Multivariate Procedures for the Behavioral Sciences. Wiley and Sons, Inc., 1962.

5. Green, B.F. Digital Computers in Research. McGraw-Hill, 1963.

6. Hartman, W., Matthes, H., and Proeme, A. Management Information Systems Handbook. McGraw-Hill, 1968.

7. Kent, A. Specialized Information Centers. Spartan Books, 1965.

8. Meadow, C.T. The Analysis of Information Systems. Wiley and Sons, Inc., 1967.

9. Meadow, C.T. and Meadow, H.R. "Organization, Maintenance, and Search of Machine Files." In Cuadra (Editor), Annual Review of Information Science and Technology. Vol. 5, Encyclopaedia Britannica, 1970.

10. Olle, W.T. (Chairman). A Survey of Generalized Data Base Management Systems. CODASYL Systems Committee Report, ACM, May 1969.

11. Orlicky, J.A. The Successful Computer System: It's Planning, Development, and Management in a Business Enterprise. McGraw-Hill, 1968.

12. Senko, M.E. "File Organization and Management Information Systems." In Cuadra (Editor), Annual Review of Information Science and Technology. Vol. 4, Encyclopaedia Britannica, 1969.

13. Silberman, H.E. and Filep, R.T. "Information Systems Applications in Education." In Cuadra (Editor), Annual Review of Information Science and Technology. Vol. 3, Encyclopaedia Britannica, 1968.

TOWARDS A TECHNOLOGY OF R&D PLANNING

Monte Penney[1]

Research may be defined as an ordered process for gaining knowledge. The accretion of knowledge about a given phenomenon occurs through the gradual specification and elaboration of its properties and its relationships to other phenomena. A key point in the development of an area of inquiry is reached when the existing knowledge base is sufficient to permit organized attempts at solving problems or adding new capabilities to the human repertoire. When attempts of this sort succeed, the results are tangible: the eradication of a disease or the completion of a space flight.

Successful R&D planning then, is analogous to scientific research in that it is an iterative process for obtaining better and better approximations of the logic inherent in natural phenomena. This is not to say that planning is--or will ever be--an experimental science; its role is rather to reduce gross uncertainties into smaller ones which <u>are</u> amenable to scientific solution. Planning and research, then, can and must complement each other in solution-oriented R&D programs.

A gap exists, however, between the need for R&D planning and our present repertoire of formalized techniques for fulfilling those planning needs. At best, we have one technique appropriate for use in Phases I and II of Figure I, and two or more for Phases III, IV, and V. Furthermore, the techniques for Phases I and II were developed in 1970 and 1967, respectively, and have not yet been widely institutionalized. This means that the existing techniques must demonstrate considerable success before other workers will attempt to develop alternative, and hopefully, better ones.

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Figure I

PHASES OF R&D PLANNING

Phase I	Policy Review
II	Strategic Planning
III	Tactical Planning
IV	Allocation of Resources
V	Monitoring

In order to provide a framework for discussion, I have pieced together a flow chart descriptive of five Phases of R&D planning.

Five Phases of Planning Defined (See Figure 2)

I. Initial Policy Review Phase:

Gideonse (Science, December 4, 1970) asserts that the choice of educational R&D goals is a value-loaded one which demands meticulous consideration of key policy issues. Goals survive or are displaced, depending upon the adequacy of the funding agency's studies in five broad areas:

A. What is the nature of the contexts within which a given educational R&D program operates?

(1) Social, political, economic, and philosophical;

(2) educational policy

(3) educational (delivery) systems

(4) science policy

B. What is the ultimate purpose (educational goal) of educational R&D in a given area?

C. What R&D functions, definitions, models, and descriptors are basic to understanding of--and success within--a given R&D area?

D. Who are the workers (scientists and developers) who will perform the R&D and where are they located?

E. What structures exist for conceiving, planning , and implementing R&D programs in a given area?

Figure 2

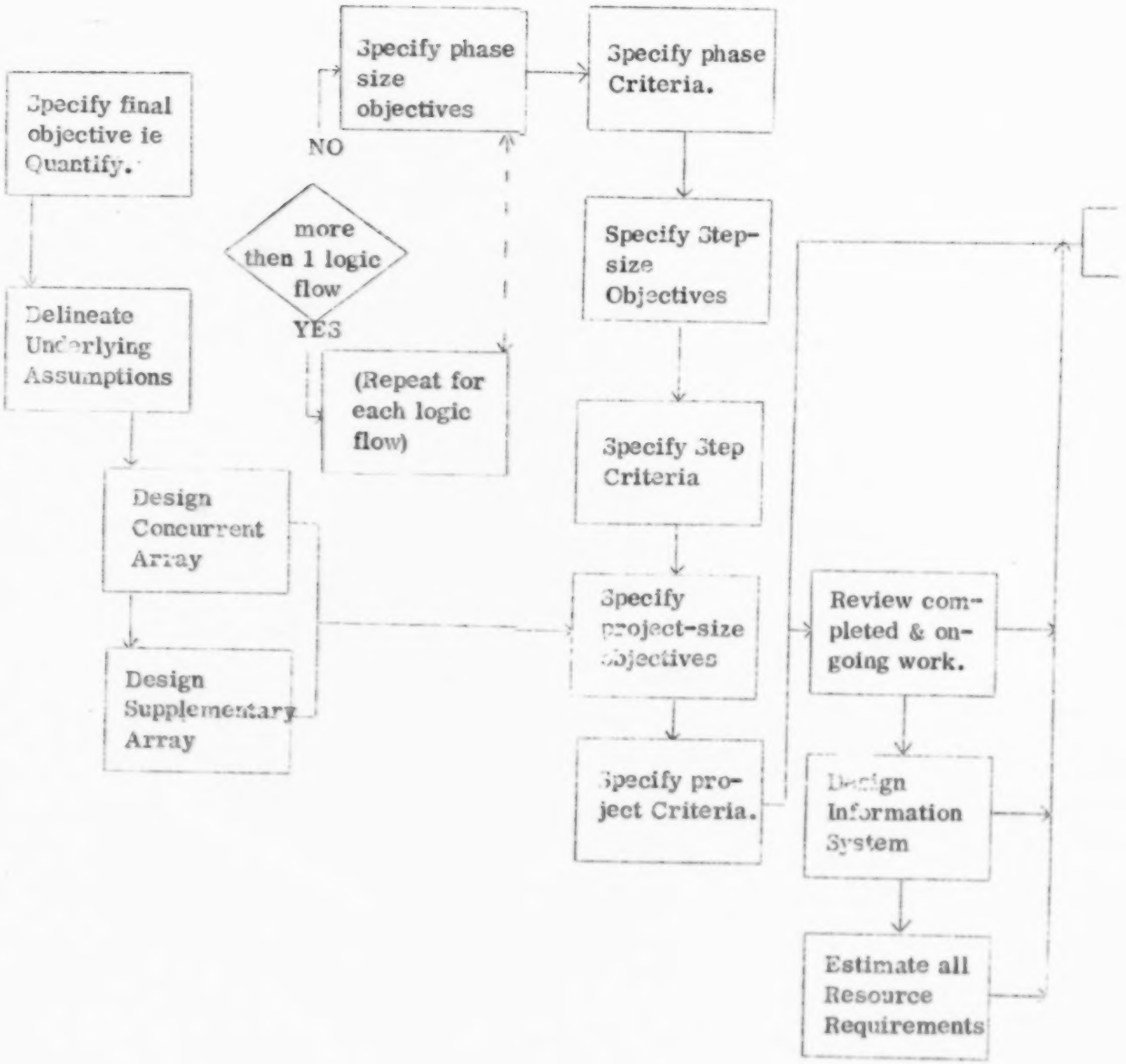
THE PLANNING AND IMPLEMENTATION OF A RESEARCH AND DEVELOPMENT PROGRAM

Phase I: Policy Review

Area	Conduct of Review	Criteria for Adequacy (Examples only)
Contexts		Peer Judgment
Educational Goals		Peer Judgment
Research Definitions		Glossary obtains Peer acceptance
Manpower and its Location		1. cannot identify additional manpower 2. Working rapport.
Decision Structures		Analysis of existing Structure is validated.

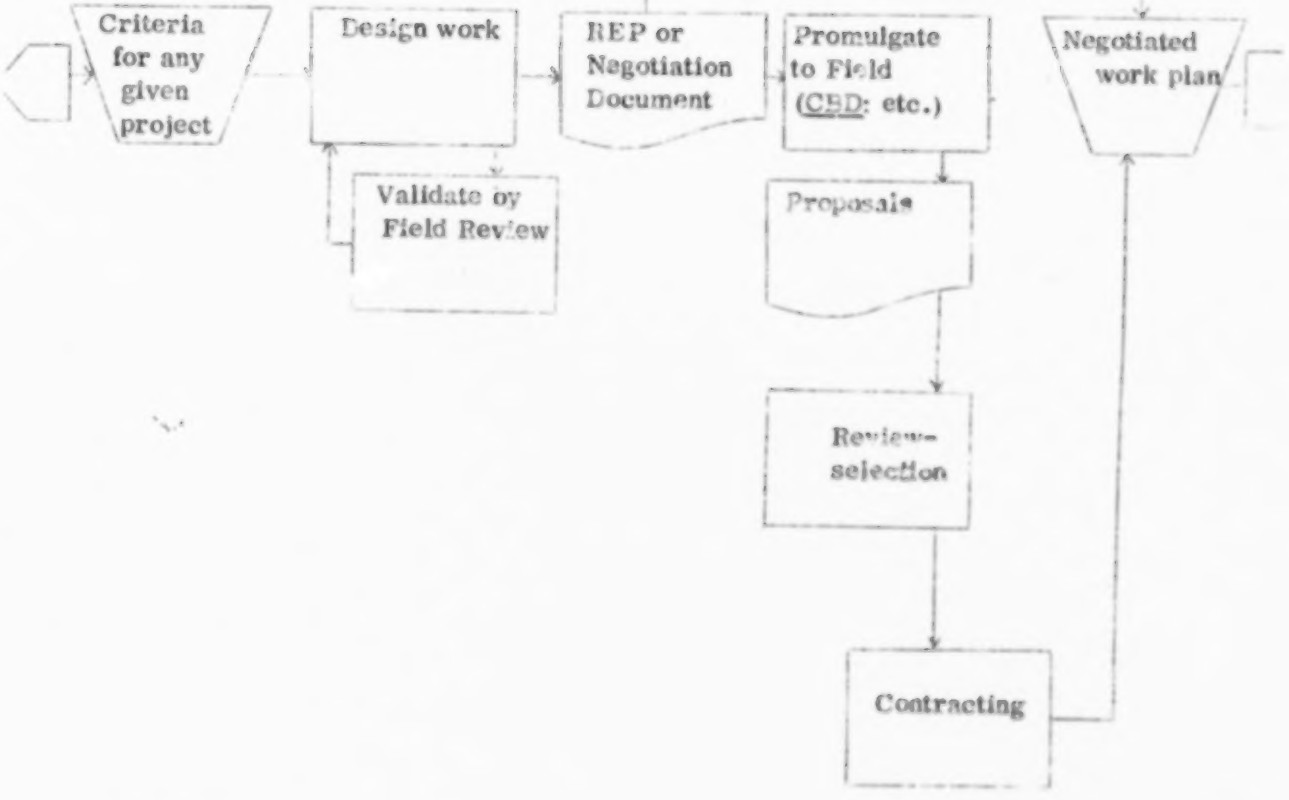
Final Program Goal and Justification

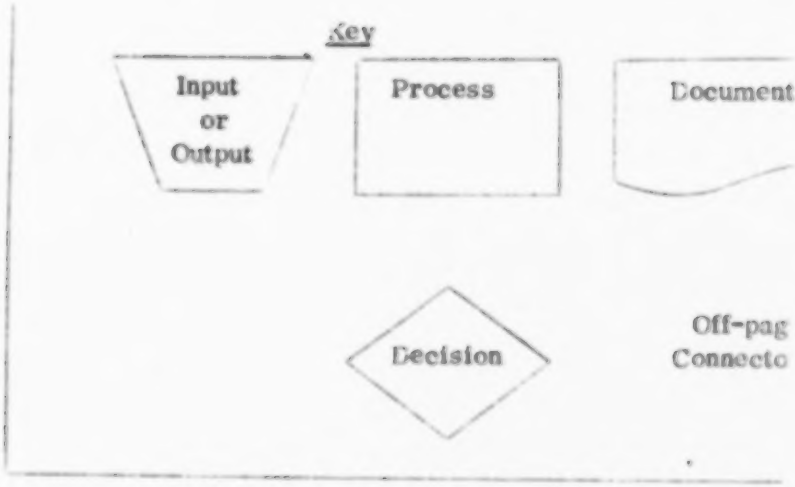
Phase II: Strategic Planning



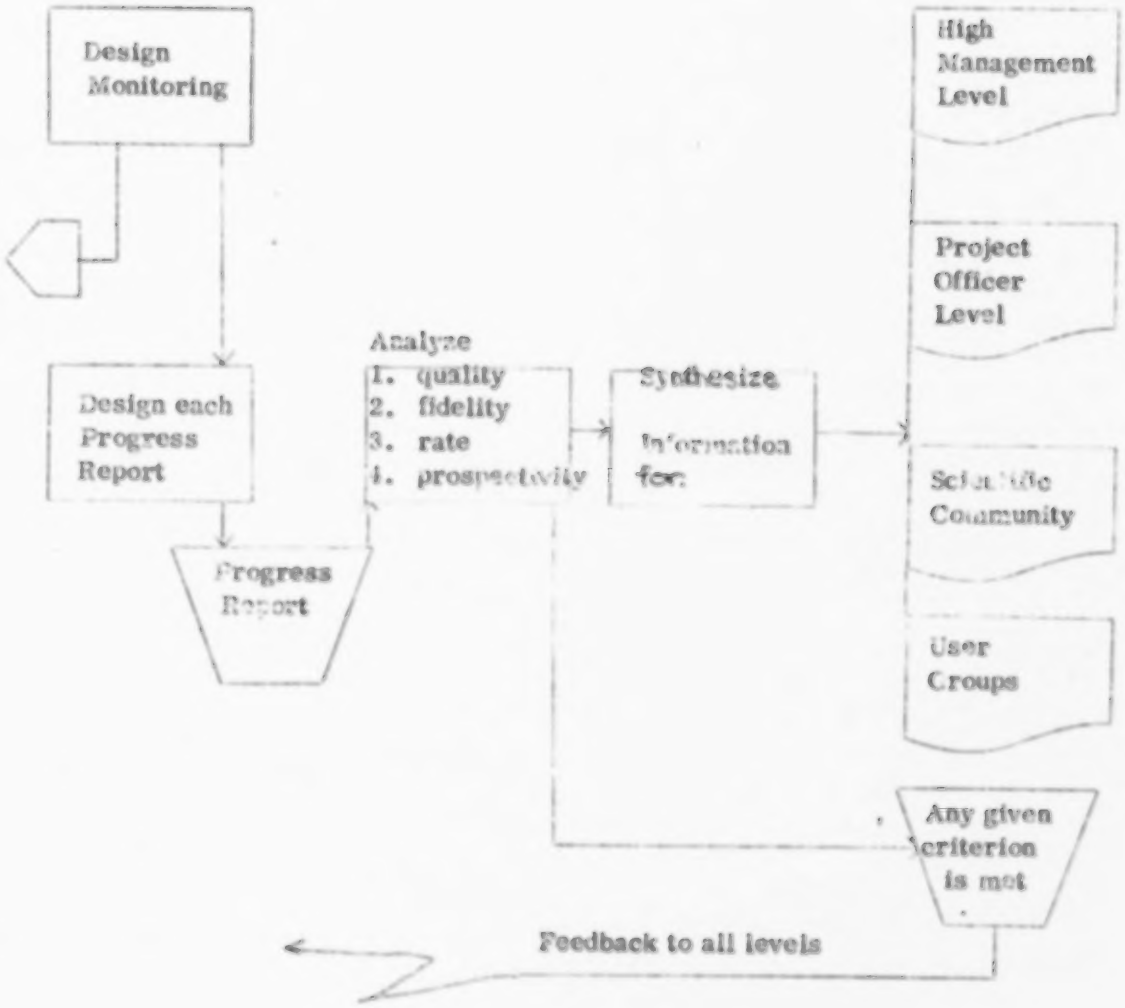
Phase III. Tactical Planning

Phase IV. Allocation of Resources





Phase V: Monitoring



The initial policy review is complete when a program goal has (1) been specified and (2) been justified from each of the five points of view described above.

II. Strategy Phase:

Carrese and Baker (Management Science, April, 1967) acknowledge that the stategic vs tactical dichotomy depends upon one's point of reference: top leadership may view a massive R&D program as but a single tactical element in some larger structure. For our purposes, we will define the strategy stage of planning as structuring coherent, goal-oriented, multiproject programs.

A step-by-step procedure for planning at the strategy is evolving through the operations of the National Cancer Institute and the U.S. Office of Education. Called the Convergence Technique, it will be treated here in some detail because it is the most highly developed of the for - malized approaches to strategic R&D planning.

The developers of the Convergence Technique reasoned that, because research is a process of exposing the inherent order--or logic--of natural phenomena, then the logic of the phenomenon under study is the best guide for sequencing and specifying the research needed to get a functional understinding of it. Therefore, research conducted according to a plan which very closely approximates the logic of the phenomenon under study will progressively reduce the number of unanswered questions, allowing funds and talents to CONVERGE upon the remaining questions. This is the basic concept of the Convergence Technique.

ORGANIZING PRINCIPLES OF THE TECHNIQUE

Several organizing principles have been found useful in applying the Convergence Technique to research problems. The specification of a final goal is the most critical of these, because it determines the nature of the research program. In formulating the plan for the Special Virus Leukemia Program, National Cancer Institute planners could have chosen as a goal to "develop techniques for early diagnosis of leukemia." Such a goal might have required research to identify the first symptoms that appeared. Instead, they chose the goal "Routine and widespread use of

preventive and/or control measures for leukemia." This goal requires identification of the causes of leukemia and development of drugs which prevent and/or control the disease. An appropriately stated final goal should indicate the kinds of research needed; or as Carrese and Baker state, it must "serve as the basis for action." Goals must neither be diffuse (e.g., to improve mankind's existence) nor lacking in perspective (e.g., to test some single hypothesis.) The Language used for stating a goal should be as concrete as possible; abstraction tends to increase ambiguity and often provides elegant though unintentional camouflage for empty concepts.

Having specified a final goal, a convergence planning team identifies and sequences the sub-goals that must be achieved to accomplish the final goal. The sequence of these intermediate goals approximates the logical structure of the phenomenon, given what is known at the time of planning. The establishment of intermediate goals is accomplished in the same manner as the final goal.

CRITERIA FOR GOAL ATTAINMENT

Specification of final and intermediate goals provides a skeletal outline of the logic system to be followed. But without criteria for the satisfaction of these goals it is an incomplete plan. For example, if one intermediate goal is to develop a test, then criteria for acceptable validity and reliability of the test and perhaps for ease of administration and scoring should be specified.

Every research project undertaken in the overall program meets two kinds of standards: standards for scientific rigor AND standards for relevance to the program's goals. Because the criteria for goal attainment provide relevance standards for the program, they aid in assessing progress, in determining what new information is needed, and in making program modifications.

THE PLANNING TEAM

Obviously, the abilities of the people who determine goals and criteria have a great deal to do with the plan's ultimate accuracy in approximating the real order of the target phenomenon. Experience

indicates that a group of more than five or six will experience problems of semantic diversity and communication time that make planning inefficient. Because of this each team member must represent a distinct, needed specialty with as little overlap as possible. According to Carrese and Baker, the basic team is composed of three members:

(a) "one person who has a general, comprehensive knowledge of the broad area of research and the major scientific disciplines in which the substance of the program to be planned is included;

(b) one person with specialized knowledge of and experience in the conduct of research in the particular area to be planned... ; and

(c) one person (usually sufficient) with general system analysis knowledge and direct experience in the use of the planning technique."

This core membership may be enlarged by adding other specialists as needed, up to the practical limit of 5 or 6.

THE PLANNING SESSIONS

The planning team must be prepared to devote a large, uninterrupted block of time to forging the plan. Every idea presented is pursued to one of three logical end points:

(1) the concept is relevant to intermediate or final goals;

(2) it is not relevant; or

(3) with specific modifications, it would become relevant

This process, which is both exhaustive and exhausting, should ideally continue until the logic system is very highly developed. The planning team, however, does not work in total isolation. It should have prearranged access to library materials and consultants. Review of interim drafts of the logic system can be performed by other experts while the planning team moves ahead.

THE CONVERGENCE CHART

The planning team obviously cannot keep all the relevant details in mind throughout a 4- to 8-week session. Tape recordings and photos of blackboard notes are good devices for short-term storage, but the Convergence Chart is the continuously developing model of the program to be conducted.

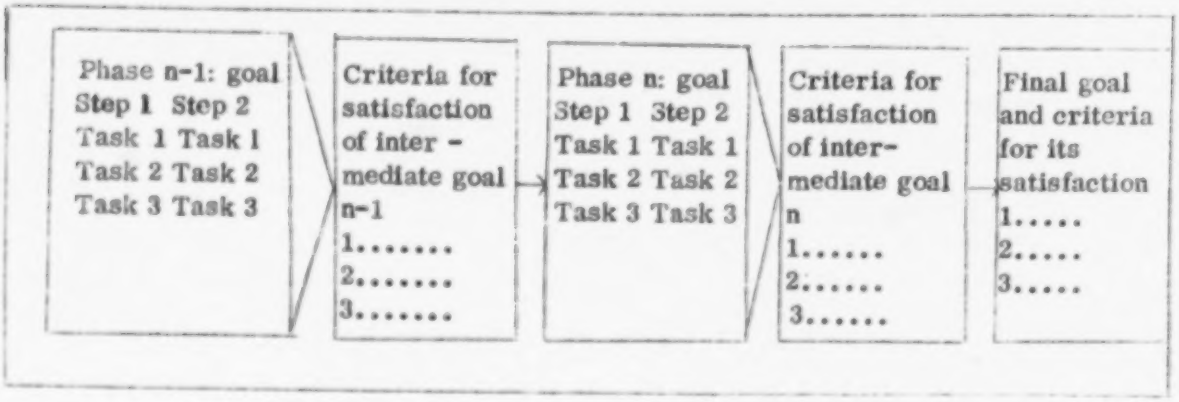


FIGURE 3

Figure 3 shows the typical format for charting a program's logic system or linear array. Specified in this array are the activities judged to be necessary to the attainment of intermediate and final goals. If the logic of a given area of research so requires, the linear array may branch or contain parallel lines of investigation. For example, the National Cancer Institute's program on lung cancer includes work on development of a cancer-free cigarette in addition to work on diagnosis and controls of the disease. The linear array is intended to display the best available knowledge and estimates of the work involved in attaining the final goal. Because it contains both relatively "hard" information and relatively "soft" information, it is the focus of continuing re-examination and modification in light of new findings.

Two additional arrays are constructed. The concurrent array shows research tasks which provide alternative approaches or promise to optimize performance in the linear array. The supplementary array is composed of long-range, "high-risk" activities, which, if successful, could cause major changes in the logic of the linear array. Tasks in

the linear array receive first priority for funding; if all of the tasks in the linear array can be funded, then work can begin in the concurrent array. The tasks in the supplementary array are funded last. Figure 4 shows a Convergence Chart with some detailing of all three arrays of the research flow.

The Convergence Chart of a research program also requires specification of a system for transmitting timely information to everyone concerned. Such a system would include all project personnel, the staff of the funding agency, and other interested parties, especially researchers who wish to collaborate in the effort and scholars who wish to critique the overall plan. In figure 4, a minimal information flow would report program status on a quarterly or semi-annual basis, as necessary. The structure provided by the linear array allows progress reports to be both concise and concrete.

The Resources Flow section of a Convergence Chart specifies the kinds of talents and facilities needed, and the approximate cost of each phase of the research.

Although the Convergence Technique is a formalized system for planning research programs, it is not a closed system. The planning begins with the construction of a "rough draft" of the target phenomenon's inherent logic, but this is only a beginning. The plan is not considered a blue-print to be followed slavishly; instead, it is a structure which is expected to receive extensive modification through professional criticism and through careful analysis of research findings.

III. Tactical Phase:

Tactical planning is the designing of constituent project-sized pieces of work to satisfy program criteria. Educational R&D is stongest at this stage: educational researchers and developers are prodigious builders and users of tools for this purpose. The tools of tactical planning include research design procedures; conceptual models (eg. CIPP); computer programs for costing, controlling, data-analysis, and scheduling: and many others. Tactical planning culminates in decisions about how individual projects should be accomplished, who is likely to have competence in accomplishing them, and the like.

FIGURE 4

Research Flow	Linear Array	Phase n-1: goal Step 1 Step 2 Task 1 Task 1 Task 2 Task 2 Task 3 Task 3	Criteria for satisfaction of inter - mediate goal n-1 1. .... 2..... 3.....	Phase n: goal Step 1 Step 2 Task 1 Task 1 Task 2 Task 2 Task 3 Task 3	Criteria for satisfaction of inter - mediate goal n 1..... 2..... 3.....	Final goal and criteria for its satisfaction 1..... 2..... 3.....
	Concurrent Array	Task (a)		Task (b)		Task (c)
	Supplementary Array	Task (x)		Task (y)		Task (z)
Information Flow		Progress reports from each project ——— to Agency ——→		Consolidated program progress report ——— to investigators (re-cycle) ——→		
Resources Flow	Personnel					
	Facilities					
	Cost					

IV. Allocation of Resources Phase:

This is the business of securing contractual relationships with institutions which will perform the work. This stage may occur in Universities (through delegation of tasks to staff or graduate students); in business or non-profit firms (through assignment of tasks to a lab or division); or in the Federal government (through assignment to staff scientists or procurement via negotiation or RFP).

V. Monitoring Phase:

As a research or development project progresses, there is often a need to re-design portions of it, and efficient re-design requires constant accurate information about ongoing work.

Monitoring is defined by Terselic and Carrese (National Contract Management Journal, 1969 V.3 No.2) as "The function or process of continuous evaluation of an ongoing research and development task by scientists expert in the subject matter of the task, in terms of achievement towards task objectives and with concern for resource utilization." Monitoring then, is "an evaluation function requiring a gathering of information depicting progress."

Viewed as simple system, project monitoring has these components and processes, as shown in Figure 5.

FICURE 5

PROJECT MONITORING

Inputs	Process	Outputs
1. Design of a given R&D task.	1. Analysis of Input 4	1. Report designe for
2. Management plan derived from (1).	(a) quality of work	(a) project officer
3. Reporting plan derived from (2).	(b) fidelity to objectives	(b) higher management
4. Information derived from 1,2,3, and from conduct of the work.	(c) rate of performance	(c) scientific community
	(d) Prospectiveness	
	2. Systhesis of information for appropriate levels of management	

Feedback

Many R&D managers might consider only phases I, II, and III to be planning functions. Once the notion of a true planning cycle (one in which R&D outputs directly influence future R&D tasks is introduced, however, it becomes clear that all five phases must be viewed as parts of a coherent whole.

A Model for the Evaluation of Management Planning Techniques

J. William Smith and John L. Yeager[1]

With the passage of the Cooperative Research Act in 1954, there has been an increasing public interest in the development of new educational programs throughout the nation. In response to this interest, the Federal government has increased its allocation of resources for research and development in education. This larger pool of resources has enabled the researcher to mount significant R&D Programs that transcend parochial concerns in order to address more critical and pervasive problems. As a direct result of this expanded support of research by the Federal government, larger and more complex research programs were formulated requiring management techniques not typically found in the general field of education. Particularly, attention was given to the utilization of planning techniques in order to systematically study alternative actions in terms of costs and probability of success. At the present time, there is even greater emphasis given to the planning of R&D Programs that have resulted from the plateauing of Federal resources concommit with an increasing public demand for the resolution of pressing educational problems.

This concern for planning has been evidenced by the government in terms of the various planning studies it has funded over the past years, as exemplified by the support given to Cook's work in the development of an educational project management theory utilizing the Program Evaluation and Review Technique, Gephart's application of the Convergence Technique to research in reading, and the development of a Program-Planning-Budgeting-Evaluation System by the Research Corporation of the Association of School Business Officials.

The implications are clear that planning activities will continue to attract significant interest from the Federal government, and consequently will exert a major force on the direction and scope of educational research activities.

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The purpose of this paper is to examine briefly the mechanics of some of the most commonly used planning techniques and provide a basis for selecting an appropriate technique for a researcher faced with limited financial resources who must achieve a specific research objective within a given period of time.

Towards this end, I will discuss Program-Planning-Budgeting -Systems and the Convergence Technique as techniques to be utilized for developing major research efforts encompassing many projects on a programmatic basis. Secondly, I will describe bar-charting and the Program-Evaluation-Review-Technique as means of enhancing research management on a project level. The final part of this paper will deal with the development of a cross reference chart designed to assist the research manager in the selection of a proper planning technique for his particular research effort.[1]

Program-Planning-Budgeting-Systems, generally referred to as PPBS, lends itself to the concept of a comprehensive plan because the technique requires the grouping of similar activities on a program basis and involves planning over an extended period of time, generally three to five years. The primary purpose of PPBS is to provide a mechanism for the analysis of alternatives within a framework of resource allocation.

Operationally, the system requires the identification of research objectives and the development and analysis of programs aimed at attaining these objectives. The programs are then translated into budgetary requirements reflecting all of the resources required for the sucessful implementation of a given program. The program required to meet a specific objective is the central element of the Program-Planning-Budgeting-System and as Cleland and King have stated[2], the program is output-oriented: it is defined in terms of what achievement is being sought, rather than what resources or inputs are available.

A major problem facing the researcher in defining a program lies in the relationship between programs and objectives. Research objectives are often ill defined, thus poorly stated in operational terms. Therefore the objectives, which serve as a basis for program definition, must be

stated by the researcher in such a manner that the activities required by attainment of the objective can be identified and stated. Indeed, Foster [3] has defined a program as "the sum of the steps or interdependent activities which enter into the attainment of a specified objective."

As the programs are precisely defined and budgeted, their cost and benefits can be projected, thus providing a cost-effectiveness basis for evaluating alternative programs. Once this analysis has been accomplished and the major programs selected and budgeted, the plan is formalized by the preparation of a "Program and Financial Plan." Cleland and King [2] have defined the "Program and Financial Plan" as a statement of the program structure covering, on a year to year basis, a period of years determined by the nature of the organization's objectives and operations, all within the format of a financial plan. This plan should reflect the optimum level of resources required to achieve the program objective. Re-evaluation of changes in funding or changes in organizational components would, as the need became apparent, dictate any necessary changes in the projected plan.

In specific terms, a properly implemented PPBS should, according to Culbertson, [4] enable an organization to:

1. "Make available to top management more concrete and specific data relevant to broad decisions;

2. Spell out more concretely the objectives of programs;

3. Analyze systematically and present for management review and decision possible alternative objectives and alternative programs to meet these objectives;

4. Evaluate throughly and compare the benefits and costs of programs;

5. Produce total rather than partial cost estimates of programs;

6. Present on a multi-year basis the prospective costs and accomplishments of programs;

7. Review objectives and conduct program analysis on a continuing, year round basis instead of on a crowded schedule to meet budget deadlines."

Perhaps a good illustration of the purpose of PPBS in an educational environment has been shown in the introductory statement of the PPBS Instruction Manual of the University of Pittsburg, which in part states:

> "During the past several years, the University has been developing a Planning, Programming, Budgeting System (P.P.B.S.) to provide a means for communi - cation within the University and a rational basis for planning and budgeting. Through such a system the various departments and areas will have a uniform means for communicating the scope of their programs in terms of the resources required (finances, staff, space, etc.) while at the same time demonstrating what these programs produce (graduates, courses, research units, publications, etc.). A more clear understanding of the specific programs which de - partments are providing, or proposing to provide, and the interrelationships between these programs now becomes possible. Such an understanding will facilitate the process of decision-making at all levels among all interested parties--faculty, students, and administrators. By directly associating the budget with specific programs and program levels, the actual pattern for use of University financial resources is made known and better informed budgetary decisions are possible."

Clearly then, the advantage of PPBS lies primaryly in its ability to show the interrelationship between program efforts and in the provision of budgetary statements which can be used for analysis of alternatives.

While PPBS is well suited as a master planning technique for organizations with many objectives, its usefulness to major research-oriented programs might be limited if the research is such that the solution to a particular problem requires a wide range of activities aimed at the attainment of one particular objective. Typical of this type of research effort is the U.S. Office of Education's program of research on the problems of reading. An outgrowth of this program was the examination of the Convergence Technique as a planning device for education.

As Gephart relates,(5) that while personnel in several funding agencies had begun to explore means for mounting a concentrated attack on the problem of reading, there also existed a pessimism about the effectiveness of programmatic efforts because of the failure to generate program proposals which could be cummulated for a problem solution. Because of this situation a decision was made to apply the Convergence Technique to basic studies in reading in an effort to develop a comprehensive, long-term reading program.

Applications of the Convergence Technique involves the formation of a planning team, usually consisting of specialist and generalist in a particular field, as well as a systems analyst. This planning team is responsible for defining the objective and sub-objectives of the program. The sub-objectives are then sequenced so as to depict a logical movement towards the major objective. The planning team is also responsible for determining the research activities required to achieve each sub-objective and establishing some criteria for this achievement.

At the conclusion of planning activity, a diagram, or Convergence Cahrt, is constructed. This chart is then a basis for determining the projects to be undertaken and the order in which they are to be started. Progress of the activities is then monitored and the plan is updated if necessary as the program progresses.

Gephart(5) has explained the management functions of the Convergence Technique in terms of examination of the project results against the relevant sub-objective criteria. As the criteria for one sub-objective is satisfied, work towards the next sub-objective is begun. He further relates that if the criteria for the sub-objective is not met, the logic of the program must be re-examined to determine if the plan should be changed or if additional work on the sub-objective is

necessary. This process is repeated until the program objective is accomplished.

The basic advantage to research activities of this technique lies in the assumption that not all necessary activities can be clearly identified in advance. The technique recognizes that research efforts involve numerous unknown factors. The logic is that as progress is made the number of unknowns should decrease and the research efforts converge on a single solution. This is best illustrated by reviewing an example of a Convergence Chart. If you examine Figure I of your hand-out, which is a typical example of an over-all convergence chart, you can see the flow of activities and the arrays which depict the activities of the planning team as well as the mechanisms for monitoring resource allocation and information flow.

The major segments of the chart are the Research Flow, the Information Flow, and the Resource Flow. The Research Flow is usually subdivided into Linear, Concurrent, and Supplementary Arrays.

Of the arrays, the main research effort, represented by the Linear Array, is subdivided into an appropriate number of flow patterns to indicate the major research sub-objectives that have been defined and to show how their completion should converge the program's progress to the attainment of the over-all obejctive. The Concurrent and Supplementary Arrays depict consideration of activities not essential to the program, but which might have a considerable effect if success - fully completed.

The Information Flow represents communication activities between program elements that are necessary to reflect the ongoing research efforts.

Resource allocation and utilization monitoring is accomplished by developing and updating the Resource Flow. A major advantage obtained from the application of Convergence Planning to research efforts lies in the logic of systematic consideration of sub-objectives, the completion of which leads to solution of the research problem .

Both PPBS and the Convergence Technique are suited for major large-scale, complex studies involving several groups and for research efforts expected to last over some extended period of time. These

planning devices are also appropriate for applications where specific tasks are not necessarily required to be completed by some predetermined exact date.

Obviously, a researcher, who is planning a more modest research effort, would find these two techniques inappropriate to his need due to the complexity of the techniques themselves. Assuming that all the components of the purposed research are known, the concepts of project management as exemplified by Project Planning Charts and the Program-Evaluation-Review-Technique could then be utilized.

Project Planning Charts, or bar charts, are an outgrowth of Gantt Charts. Charts of this nature typically consist of a scale divided into units of time across the top and project activities listed down the left-hand side. Figure II of your hand-out shows a typical example of a Planning Chart. Notice that bars or lines are drawn across the chart to indicate the schedule of each activity. As progress is made on any given activity, a second line is drawn in to show the status of the activity in relation to the time scale. Resource allocations can then be made based on the shortest reasonable time needed to complete the project.

Preparation of this type of chart requires the determination of a specific course of action to be followed in the accomplishment of the project. The course of action should be stated in terms of the necessary activities to be scheduled. Time estimates for each activity should be obtained from the person responsible for that activity. Once this information is gathered, the chart can be prepared.

Charts of this nature offer the advantage of showing the overall plan, the estimated schedule, and the current progress of the project simultaneously.

Cleland and King [2] have identified the disadvantages of this technique principally as having to plan and schedule at the same time. Since the technique is based on a time factor, alternative plans generally have to be evaluated on the basis of the initial schedule, thus minimizing the opportunity to consider plans requiring a different schedule. In addition, bar charts do not show the interdependent relationships of one activity to another. Although the technique will show the amount of time that a given activity is behind schedule, it does not clearly show the impact upon subsequent activities or concurrent activities.

These Project Progress Charts are best suited for reasonably small, short-term projects which can be easily managed by monitoring the progress of some major activities and communicating the overall status of the project.

Many of the shortcomings of progress charts are overcome by the Program-Evaluation-Review-Technique. Commonly referred to as PERT, this planning device has been investigated and tested by Cook for its appropriateness to project management efforts in education. According to Roman, [6] PERT is designed to:

> "focus managerial attention on key project developmental activities; point up potential problem areas which could disrupt project objectives; evaluate progress towards the attainment of the project objectives; give management a prompt mechanical reporting device; and, aid and facilitate decision making."

To accomplish these managerial objectives PERT utilizes time as a common denominator to reflect the interrelationships of time, resource allocation, and performance standards.

The first step in the implementation of PERT is the definition of the project objectives. These objectives are then subdivided into identifiable, easily-managed activities which are classified according to their inter-dependency relationships. As Cook has shown, [7] the subdividing and classification of activities continue until an appropriate level of detail is reached. The dependency relationships existing between activities can then be depicted by use of a network system.

Figure III shows that networks consist of circles and arrows (or appropriate substitutes). The circles represent events and the arrows activities. An event is a specific instant in time and consumes neither time nor resources. An activity is actual task or work and consumes time and resources.

The specific requirements and characteristics of network systems include:

1. The individual tasks required to achieve some objective must be defined in sufficient detail so as to be represented in the network, which is comprised of events and activities. An event represents a specific accomplishment at a particular instant in time. An activity represents the various resources, including time, which must be utilized to progress from one event to the next.

2. Events must be sequenced on the network in such a manner as to allow identification of critical paths, which depicts that chain of necessary events that in summation requires the greatest time.

3. Three time estimates are made for each activity of the network. These three time estimates are known as the most likely time, the optimistic time, and the pessimistic time. The most likely time is that time which, in the estimator's opinion, the activity will require under normal conditions. The optimistic time is that time required under the most favorable conditions. The pessimistic time is that time required if just about everything goes wrong. These three time estimates provide a basis for calculating the expected time and the scheduled time of a project. The difference between these estimates can be expressed in terms of a standard deviation and provide a probability of accomplishing scheduled time by use of the normal distribution table.

In using network systems, provisions must be made for frequent review of progress as compared to the time estimates originally given for the various activities. Since the time predictions are then compared with feedback in the form of performance data, opportunities are presented to re-allocate resources if necessary to facilitate progress along critical paths.

Network systems, then provide a large amount of information relating to activities necessary to accomplish some objective to be pre - sented in a highly ordered fashion.

By estimating the cost of each activity, it is possible to add a dimension of resource control to network systems, thus providing a better

basis for management action.

Network systems can be applied to almost any project where logical planning is required. Cook identifies several criteria that should be considered in the decision to utilize network systems.

1. "Does a specified end objective exist, the accomplishment of which can be determined?"

2. "Must some scheduled date or deadline be met?"

3. "What is the degree of project complexity?"

4. "Does a degree of uncertainty exist as to the definition of some or all program elements?"

5. "How familiar are the concepts of PERT to project personnel?"

A primary disadvantage of utilizing PERT for research activities is the lack of ability to specify with great accuracy the time elements of research activities. However, if the time elements are properly estimated this weakness need not invalidate the effectiveness of PERT to educational research.

The description of these techniques has been designed to state only the basic principles of each method and to provide some insight for its appropriate applications to the field of educational research.

Figure IV is a selection criteria chart designed to assist the researcher in selecting an appropriate planning device for his particular needs. A review of this chart will indicate some considerations that should be taken and the consequences that would result from the selection of any of these techniques.

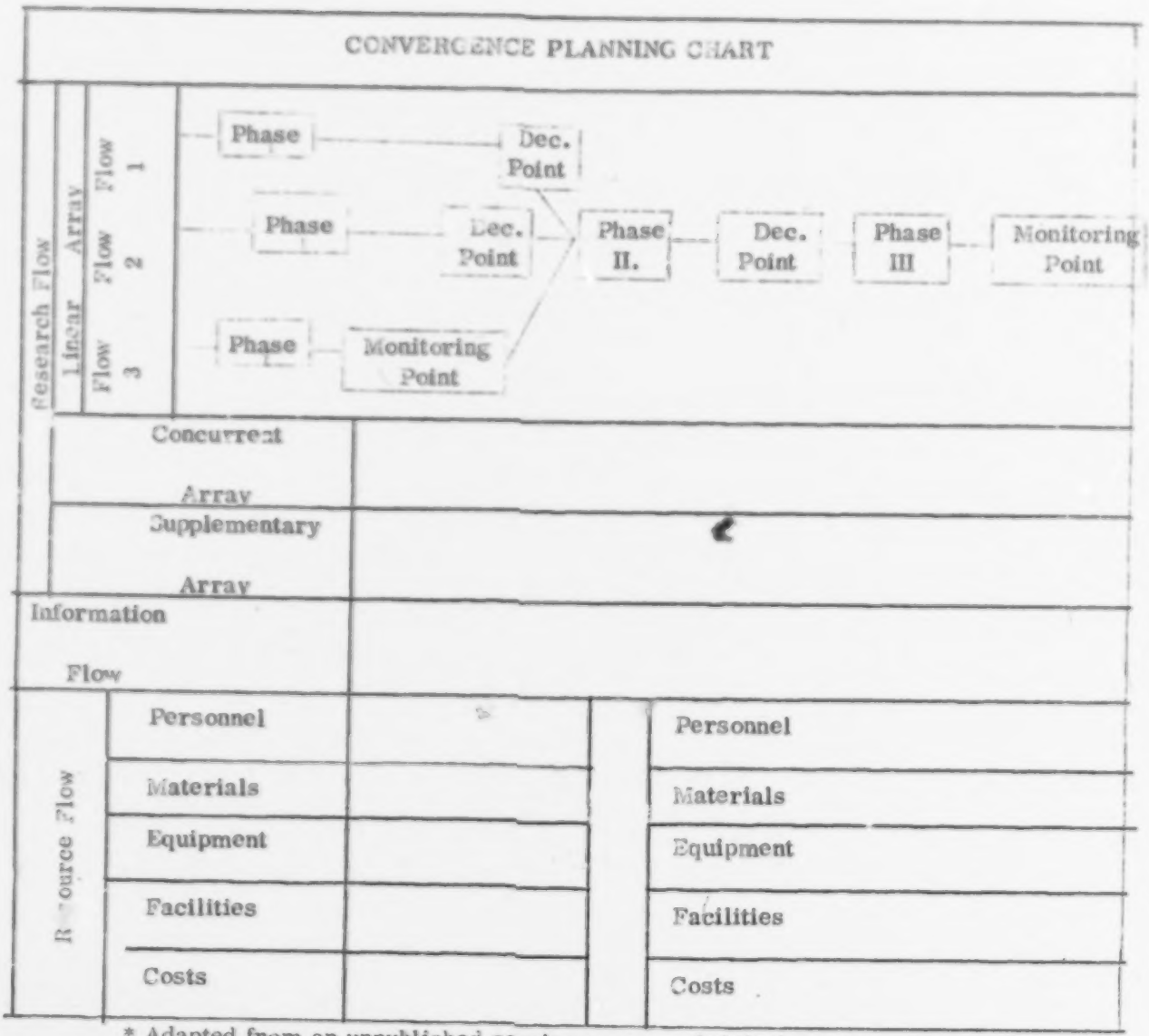
The criterion listed in this chart and the corresponding ratings are not to be interpreted as absolute values for all research situations, but rather as an indication of the appropriateness of the technique for a "typical" situation. The criteria represents an initial attempt to identify

selected characteristics that indicate whether or not a particular technique should be applied to a given research activity.

It has been my purpose in this paper to identify the basic features of four techniques that can and have been used in educational endeavors and to relate some meaningful criteria that will assist educational researchers in the selection of an appropriate planning device. It is anticipated that as the general area of planning receives increasing attention by the educational community, new planning techniques and criteria will evolve. This will permit the researcher to more effectively conduct his research activities.

FIGURE I

CONVERGENCE CHART



* Adapted from an unpublished seminar paper: Original source unknown.

FIGURE II

PROJECT PLANNING CHART

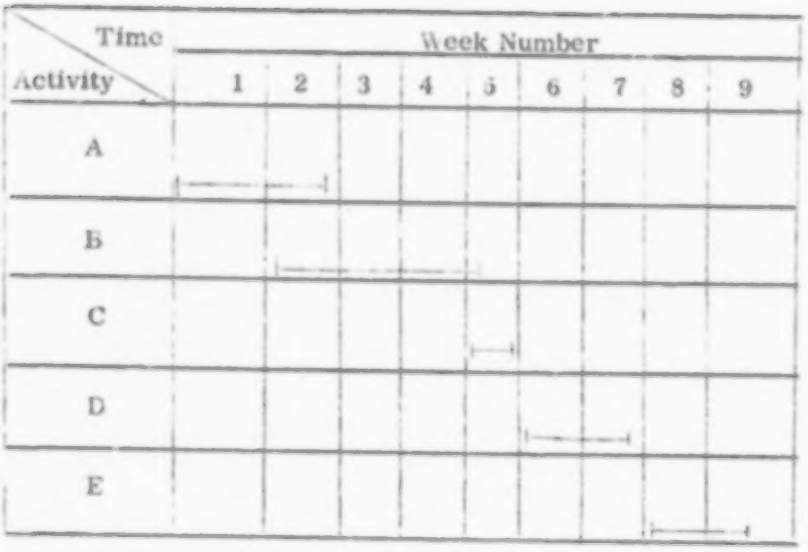
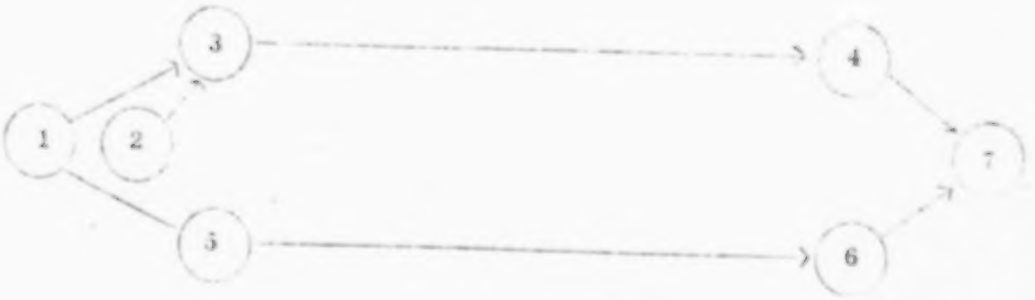


FIGURE III

PERT NETWORK



Number	Task Description
1 - 2	Activity #1
1 - 3	Activity #2
1 - 5	Activity #3
2 - 3	Activity #4
3 - 4	Activity # 5
3 - 5	Activity # 6
4 - 7	Activity # 7
5 - 6	Activity # 8
6 - 7	Activity # 9

○ = Events ⟶ = Activities

FIGURE IV

SELECTION CRITERIA

Key 1 = Low application of statement to technique
2 = Moderate application of statement to technique
3 = High application of statement to technique

I. The technique is best suited for:	Bar-charts	PERT	Convergence	PPBS
1 - Complex multi-organization research effort	1	2	3	3
2 - Single objective-project research	2	3	1	1
3 - Basic research (large circle)	1	2	3	3
4 - Basic research (modest scale)	1	3	1	1
5 - Developmental aspects of educational research	2	3	1	3
6 - Identifying and analyzing alternative strategies	1	2	3	3
7 - Costing alternative strategies	1	3	2	3
II. The technique requires:				
1 - A definitive statement of the research objective	3	3	2	2
2 - Sequencing of activities	3	3	3	2
3 - The availability of highly trained personnel	1	2	3	3
4 - Consideration of alternatives	1	1	3	3
5 - Specific budgetary procedures	1	1	2	3

II. The technique requires : (cont'd):	Bar-charts	PERT	Convergence	PPI
6 - Establishment of a defined schedule	3	3	2	2
7 - Identify of specific activities	3	3	2	1
8 - Extra cost for implementation of technique to research effort	1	1-2	3	3
9 - Detailed specification of all component activities	3	3	2	1

III. The technique provides a mechanism for:

	Bar-charts	PERT	Convergence	PPI
1 - Showing the inter-relationships between tasks	2	3	3	2
2 - Depicting the inter-dependencies between tasks	2	3	3	2
3 - Establishing a basis for budgetary control	1	3	3	3
4 - Improving communication	2	3	3	2
5 - Adequate information feedback	2	3	3	3
6 - Assignment of realistic cost to tasks	3	3	2	3
7 - Determination of the reliability of time estimates	1	3	1	1
8 - Evaluation of performance on a time basis	3	3	2	2
9 - Evaluation of performance on a budget basis	1	3	2	3

Bilbliography

1. Bright, Louis R., Gideonse, Hendrik, D., "Research, Development and Dissemination Strategies in Improving Education.", Designing Education for the Future No. 3, ed. Morphet, Edgart, Ryan, Charles O., Citation Press, New York, 1967.

2. Cleland, David I., and King, William R., "Systems Analysis and Project Management," McGraw-Hill Book Co., New York, 1968.

3. Foster, Charles W., ed. "Report of the First National Conference on PPBES in Education" Research Corporation of the Association of School Business Officials, " Chicago. See, 1969.

4. Culbertson, Jack, "State Planning for Education," Designing Education for the Future No 3, ed. Morphet Edgart, Ryan, Charles O., Citation Press, New York, 1967.

5. Gephart, William J. "Application of the Convergence Technique to Basic Studies of the Reading Process" National Center for Educational Research and Development, 1970.

6. Roman, Daniel D., "The PERT System: An Appraisal of Program Evaluation Review Technique," Program Evaluation In the Health Fields: A Book of Selected Reading, ed. Schielberg, Herbert C., Sheldon, A., Baker, F., Behavorial Publications, New York, New York, 1968.

7. Cook, Desmond L., "Program Evaluation and Review Technique Applications in Education," U.S. Department of Health, Education, and Welfare, Office of Education, U.S. Government Printing Office, Washington: 1966.